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ON CORMORANT FISHING IN JAPAN.

BY P. L. JOUY.

IN the clear mountain streams of Central Japan there is found a peculiar fish of the family *Salmonidæ,* the *Plecoglossus altivelis* T. & S. This fish, the "Ai" of the Japanese, is something between a trout and a smelt in appearance, grows to a length of twelve to fourteen inches, and is a bright silvery in color, with a golden spot on each shoulder. It is very delicate in flavor, and is much prized for the table. In a country celebrated for the variety and excellence of its fish, this species holds the highest place and commands the best price in the market. Many ingenious methods are employed for its capture, among the most interesting of which is the use of cormorants.

We are all familiar with the stories of cormorant fishing in China where the fisherman has his birds trained to obey a call-note or whistle, and where they sit around the edge of the boat, and go and return to and from the water like a well-trained spaniel; but cormorant fishing in a rapid mountain stream in Japan, is quite a different thing from fishing in a sluggish, muddy river in China, and I believe that the Japanese methods are quite unknown, being carried on at *night*, and in remote and out of the way places.

Before quoting from my note-book I will preface by stating that I made a journey, of about twenty-five miles, from Tokio to a small river, the Banugawa, on purpose to witness this interesting and, to me, novel sight.

September 8th, 1886. We left the tea-house about eight o'clock to keep our appointment with the cormorant fisher. It was

a bright moonlight night, said to be a bad night for fishing, a cloudy or dull evening being preferred, as the fish were then not so active. The river consisted of two branches, running very swiftly, and each from twenty to fifty yards wide, but in flood-time it extended over a space of 200 yards or more, running between high bluffs. The man with his bird was waiting for us on the stony bed of the river, with his torch of pine-fat burning brightly. The bird (*Phalacrocorax* sp.) was very tame, and sat perched on a rock close by. A cord was tied pretty tightly around the lower part of the throat and between the shoulders, from which was attached a piece of bamboo (having a swivel at each end), long enough to extend beyond the bird's wings and prevent fouling of the cord while the bird was in the water. The man carried a basket at his side to put the fish in, and a sort of apron in front to hold pine chips for the light. The lantern was a wire cage or basket placed on the end of a long bamboo pole. This, with the cord attached to the bird, which gives him a range of about twenty feet, is held in the left hand, the right being employed in guiding the bird, replenishing the fire and taking the fish.

Everything being ready, the fisherman takes the torch in his left hand, and clasping the cord, to which the bird is attached, wades out into the stream, the bird following him and, after performing a hasty toilet, dipping his head and neck in the water and preening himself, begins the business of the night. The fisherman holds the fire directly in front and above the bird's head, so that it can see the fish in the clear water. The bird seems to be perfectly fearless, and as he comes up sparks of fire are constantly falling on his head and back.

The fishing is done up-stream, the man finding it all he could do to keep pace with the bird as the water surges up nearly to his thighs; in fact it was hard work for us on shore to scramble along among the rocks in the uncertain light and watch the bird at the same time.

The bird dives, swims under water for eight or ten yards, comes up and is down again, working very rapidly and constantly taking fish. When the fishes are small the bird is allowed to retain two or three in his throat at a time, but a fair-sized fish is immediately taken from him and put into the basket.

During a space of half an hour fifteen fishes were taken, which was pronounced a good catch considering the brightness of the

night. The largest of these fishes, which were all of the same species, were nine to ten inches in length, and having been taken immediately from the beak of the bird were scarcely bruised. The largest and best of these we had the next morning for breakfast, the others we gave to our friend, the cormorant, who was kindly assisted by his master to get them past the cord which constricted his throat so that he could not otherwise have swallowed.

The birds are trained especially for the work, and do not fish in the day-time. Our bird was two years old, and was considered a very bright and active fisher, having on good nights, fishing all night, caught as many as 400 fishes,—300 was considered a fair night's work. Only calm nights are available, and the darker the better.

THE MECHANICAL CAUSES OF THE ORIGIN OF THE DENTITION OF THE RODENTIA.

BY E. D. COPE.

THE phylogeny of the Rodentia as an order is now tolerably clear. I at first suggested,[1] and later asserted, that this order was derived by descent from the Tillodont suborder of the Bunotheria. The Tillodont suborder had a common origin with the Tæniodonta, from some type of Bunotheria with unspecialized molars and premolars, in which some of the incisor teeth had begun to display enlarged size. A form allied to this ancestor is the genus Esthonyx, which differs from it in but few respects. Professor Ryder, in discussing the origin of the Rodentia,[2] writes as follows:

"The significance of accessory rudimentary incisors present in some forms of true rodents, as pointing to the manner in which the evolution of the rodent type of dentition took place, may be overrated; yet when it is borne in mind that in other groups the appearance of diastemata between the different kinds of teeth took place gradually and in a way which unmistakably shows the gradual steps of the

[1] American Naturalist, April, 1883; Report U. S. Geol. Surv. Tertiary Vertebrata, 1885, 814; American Naturalist, April, 1884.

[2] Proceed. Academy Philada., 1877, p. 317.

process, we may be excused for thinking the same to have been the case here, although without positive tangible evidence in the shape of intermediate fossil forms that exhibit such a passage from the ordinary type." In 1852 I had the pleasure of discovering a genus [1] (Psittacotherium Cope) which supplies the desideratum wanting when Professor Ryder wrote. This is a genus, without diastema, and with two effective rodent-like incisors in each ramus of the lower jaw. Ectoganus Cope is probably similar in these respects, but only its separate teeth have been found. Psittacotherium is, then, a generalized type, and is not far from, if not directly in, the line of the ancestry of all Rodentia. It belongs to the Puerco fauna, which embraced so many of the progenitors of later Mammalia (Fig. 1).

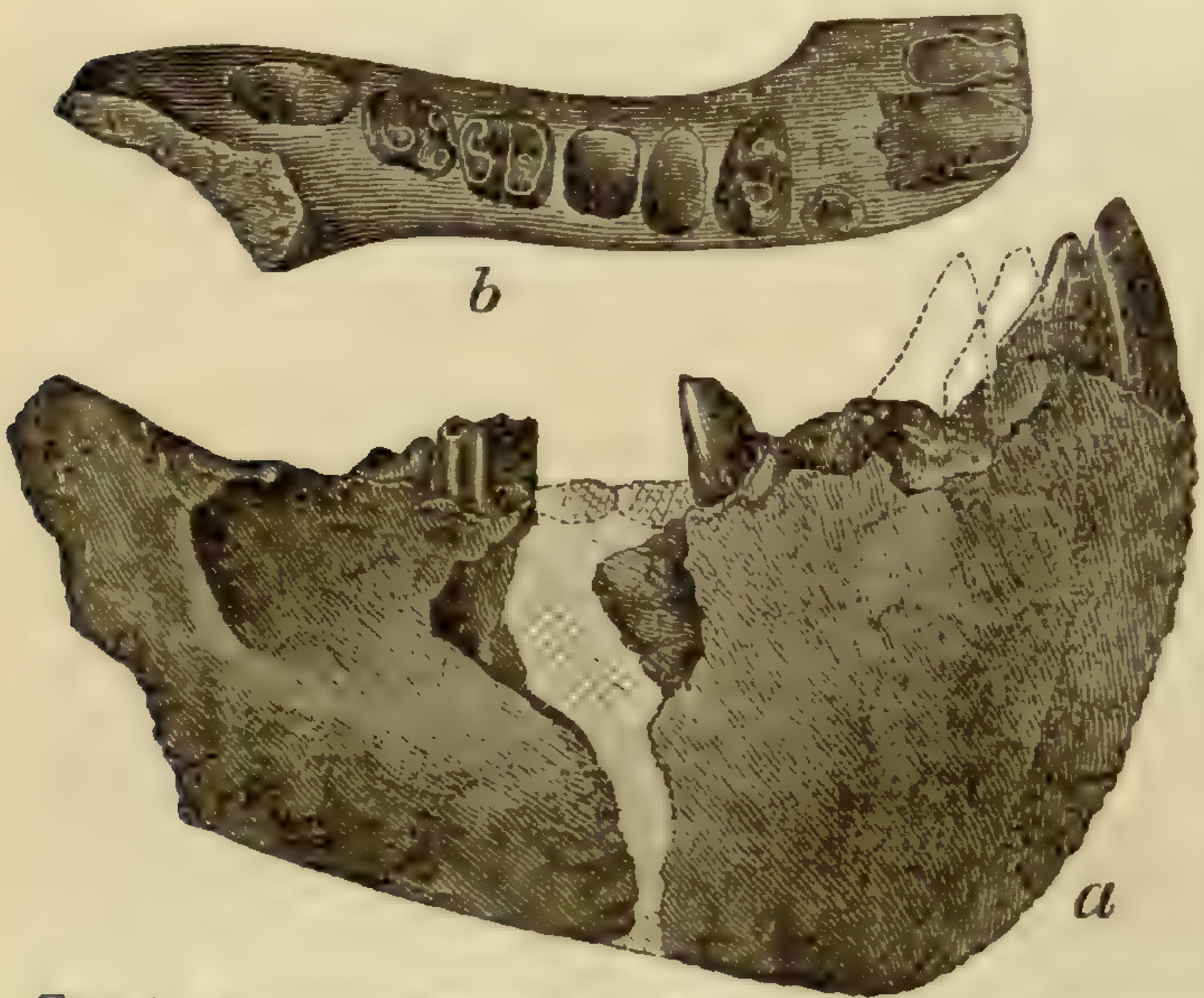

FIG. 1. *Psittacotherium multifragum* Cope, left mandibular ramus, one-half natural size. Original; from Puerco bed of New Mexico. Fig. *a*, external view; *b*, superior view.

I have called attention to the fact that the first inferior incisor is rudimental in Calamodon, and Marsh has shown the same thing in Tillotherium. In both genera the second incisor is the effective tooth. The third is present in Calamodon (Fig. 2). In Tillotherium the third incisor is apparently wanting. In Psittacotherium the first incisor tooth is present and effective, but the second is larger. It is not certain whether these are first and second, or second and third incisors. If we allow Esthonyx to decide the question, the large second tooth is truly the second incisor, for in that genus the first incisor is small, and the third is rudimental. With present information, then, the inferior incisor of the Rodentia is the second of the Mammalian series.[2]

[1] American Naturalist, Feb., Tertiary Vertebrata, 1885, p. 195.

[2] I have regarded (Naturalist, 1884, April and earlier) the Tæniodonta as the ancestors of the Edentata. The objection to this view is the supposed absence of inferior incisors in the latter. But the middle incisors

The peculiarities of the rodent dentition consist, as is well known, in the great development of the incisors; the loss of all but one, or rarely of two, of the premolars, which leaves a wide diastema; and the posterior position of the molar teeth, as relates to the rest of the skull. A peculiarity which belongs to the highest types of the order is the prismatic form of the molars, and the deep inflection of their always transverse enamel folds, both laterally and vertically. A peculiarity of the masticating apparatus, which is the basis of distinction from the Bunotherian order, is the lack of postglenoid process, and the consequent freedom of the lower jaw

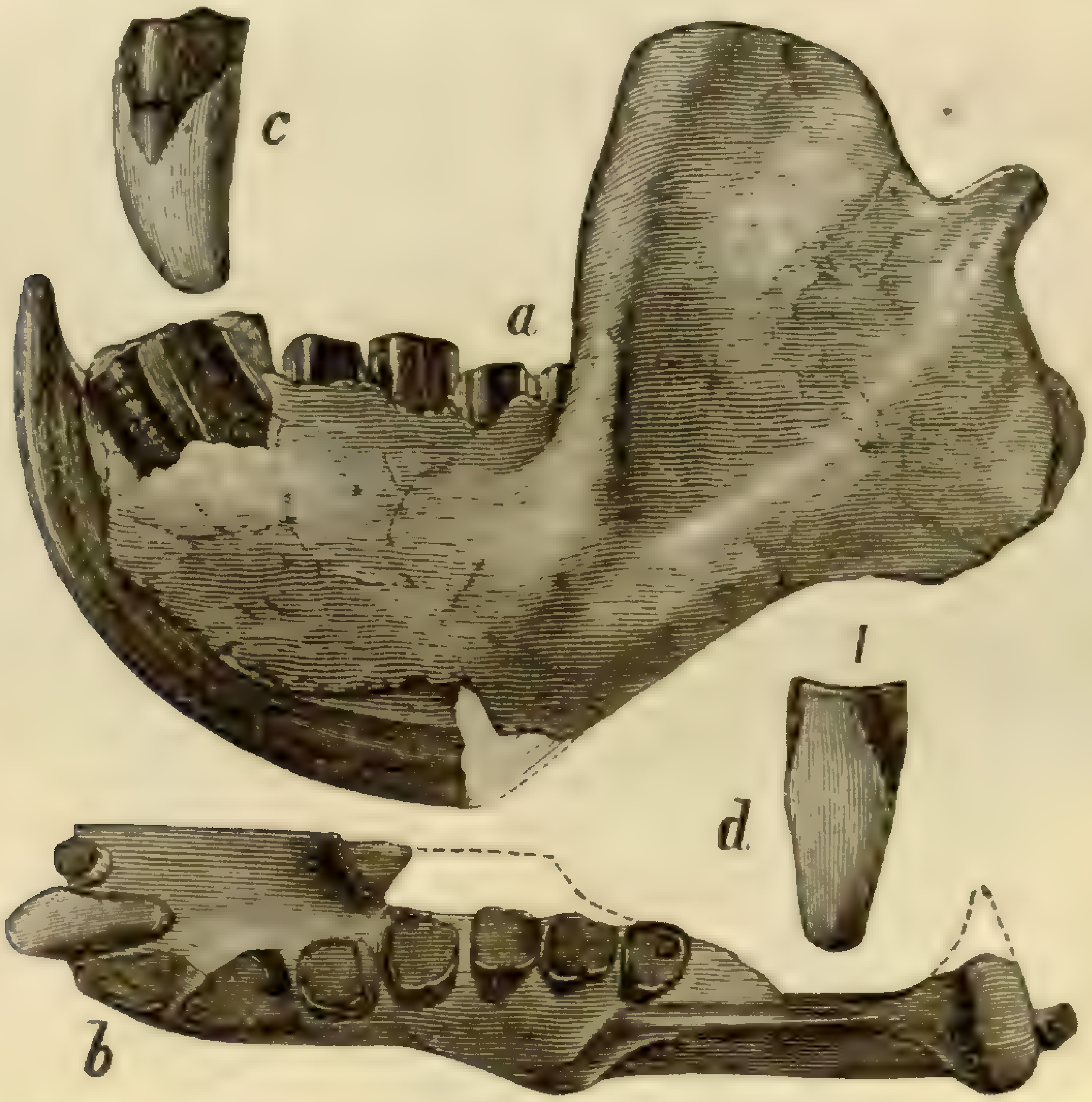

FIG. 2. *Calamodon simplex* Cope, lower jaw, left ramus, one-third natural size. Original, from Wasatch Eocene, of Wyoming. Fig. *a*, external view; *b*, superior, *c-d*, inferior molar; *c*, exterior; *d*, posterior views.

to slide backward and forward in mastication. Appropriately to this motion the condyle of the mandible is either subglobular, or is extended anteroposteriorly, and the glenoid cavity is a longitudinal instead of a transverse groove.

The mechanical action of the development of the rodent dentition has been as follows: The first factor in the order of time and importance was the increasing length of the incisor teeth.

are disappearing from the Tæniodonta, while the supposed canines of the lower jaw of Megalonyx and allies may be true incisors. This is rendered probable by the genus Diadomus of Ameghino, where the large canine-like teeth are found close together at the symphysis mandibuli, like the incisors of Tæniodonta and Rodentia.

Those of the lower jaw closed behind those of the upper in the progenitors of the Rodentia (*e.g.*, Esthonyx), as in other Mammalia. Increase of length of these teeth in both jaws would tend to keep the mouth permanently open, were it not for the possibility of slipping the lower jaw backwards as it closed on the upper. This backward pressure has undoubtedly existed, and has operated from the earliest beginning of the growth of the rodent incisors. The process has been precisely the opposite of that which has occurred in the Carnivora, where the pressure has been ever forwards, owing to the development of the canines.[1] The

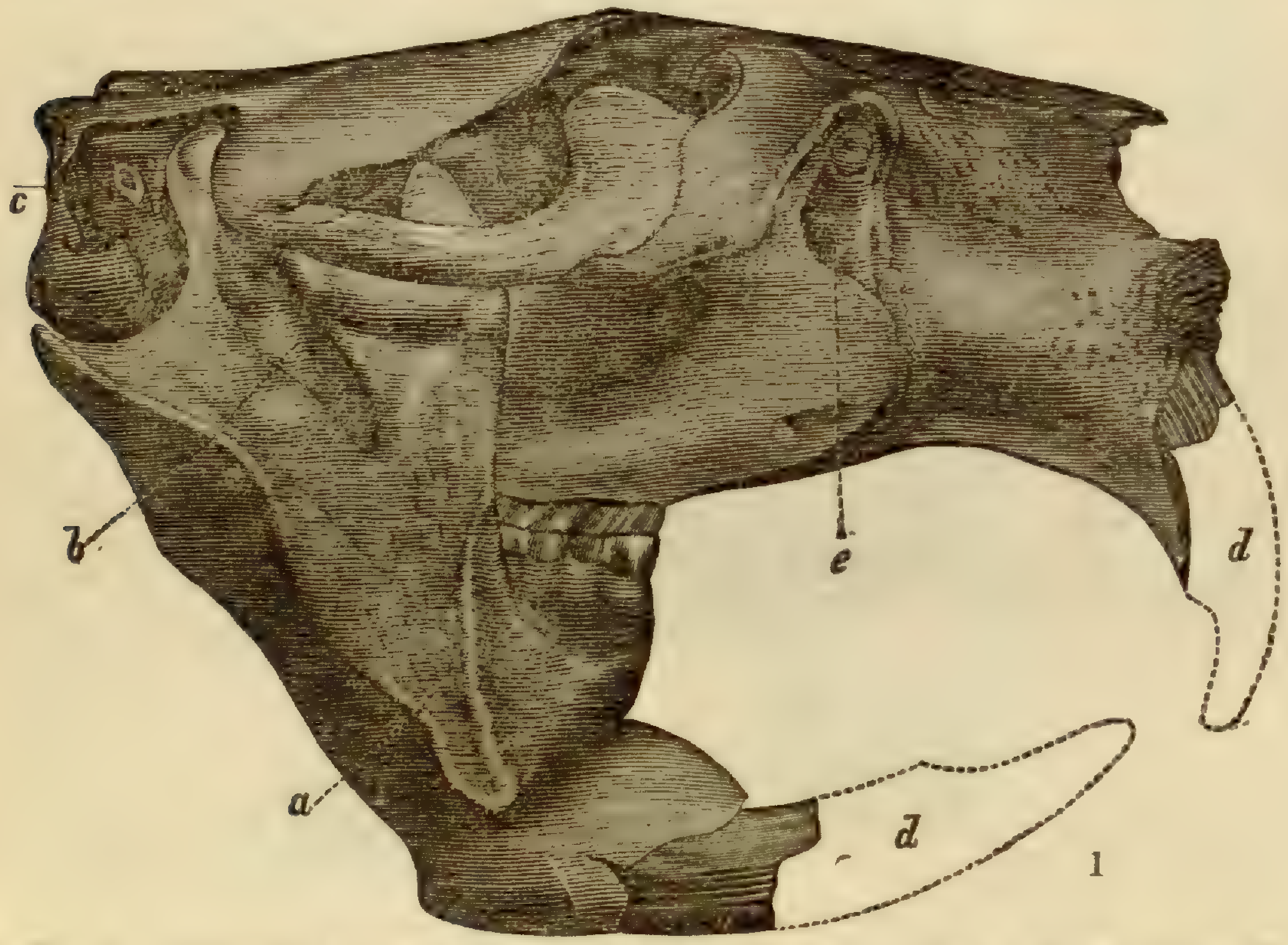

FIG. 3. *Castoroïdes ohioensis* Foster, skull, right side, two-fifths natural size. Fig. *a*, inferior insertion of masseter muscle; *b*, fossa in side of ascending ramus; *c*, external auditory meatus; *d*, incisors; *e*, foramen infraorbitale. From Hall & Wyman.

progressive lengthening of the incisors through use has been dwelt on by Professor Ryder (l. c.). The posterior pressure on the lower jaw, produced by its closing on the upper, has been increased directly as the increase of the anteroposterior length of the incisors, especially those of the lower jaw.

The first effect of this posterior pressure will have been to slide the condyle of the mandible posteriorly over the postglenoid process, if any were present, as is probable, in the bunotherian ancestor of the rodent. Continued repetition of the movement would probably push the process backwards, so as to render it ineffective as

[1] Proceed. Amer. Assoc. Science, 1887.

a line of resistance, and ultimately to flatten it out, and atrophy it. The lower jaw would thus come to occupy that peculiarly posterior position which it does in all rodents.

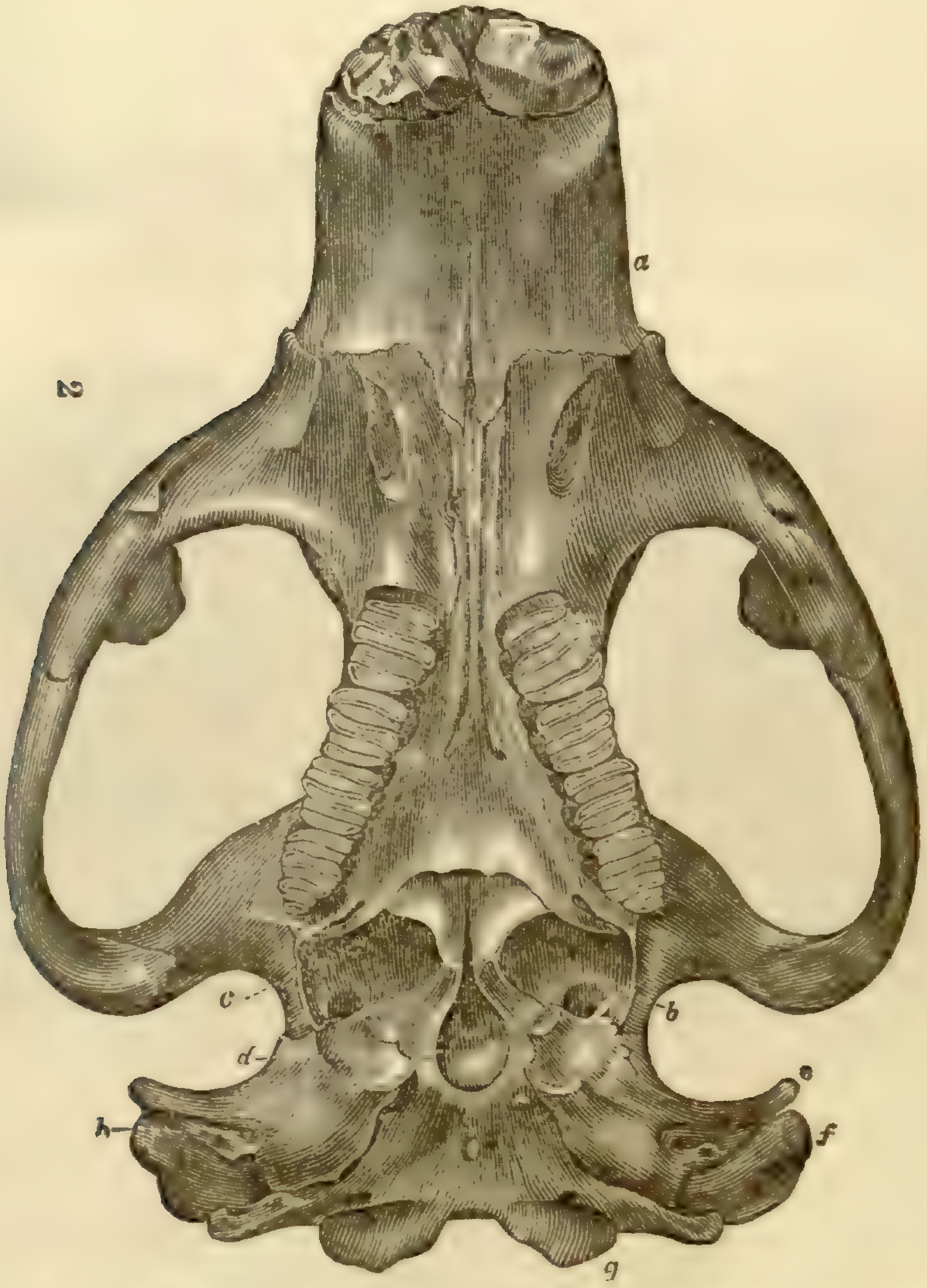

FIG. 4.—*Castoroïdes ohioensis* Foster, two-fifths natural size, skull from below. Fig. *a*, incisive foramen; *b*, pterygoid fossa; *c*, internal pterygoid plates; *d*, fossa in basioccipital bone; *e*, external auditory meatus; *f*, mastoid process; *g*, occipital condyles; *h*, tympanic bulla; after Hall and Wyman.

The anteroposterior (propalinal)[2] type of mastication becoming necessary, an appropriate development of the muscles moving the lower jaw, with their insertions, follows *pari passu*. As a result we see that the insertion of the temporal muscle creeps forwards on the ramus, until in the highest rodents (Cavia) it extends along the ramus to opposite the first true molars. The office of this mus-

[2] See Naturalist, Nov., 1887, p. 991, for explanation of the different modes of mastication. The propolinal mastication is to be distinguished into the proal, from behind forwards (the Proboscidea, Ryder), and the palinal from before backwards (the Rodentia, Ryder).

cle is to draw the ramus backwards and upwards, a movement which is commenced so soon as the inferior incisor strikes the apex of the superior incisor on the posterior side. By this muscle the inferior molars are drawn posteriorly and in close opposition to the superior molars. Connected with this movement, probably as an effect, we find the coronoid process of the mandible to have become gradually reduced in size, to complete disappearance in some of the genera, *e.g.*, of Leporidæ. In these genera the groove-like insertion of the temporal muscle develops as the coronoid process disappears.

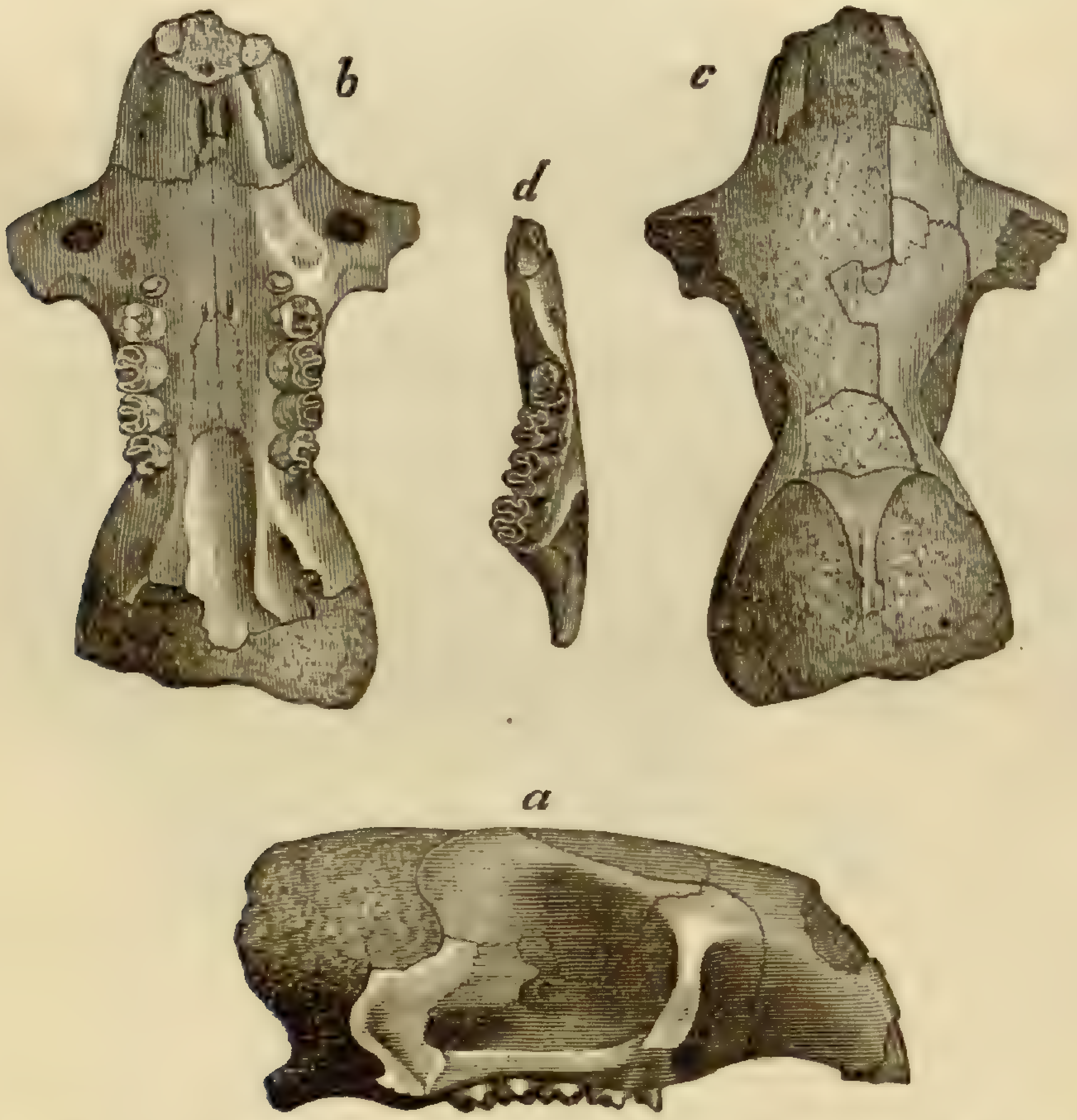

FIG. 5. *Ischyromys typus* Leidy, natural size, from the White river beds of Colorado; original, from the Report U. S. Geol. Surv. Terrs. *a*, *b*, *c*, cranium; *d*, mandible from above.

As third and fourth effects of the posterior position of the lower jaw, we have the development of the internal pterygoid and masseter muscles and their insertions and origins. The angle of the ramus being forced backwards, these muscles are gradually stretched backwards at their insertions, and their contraction becomes more antero-posterior in direction than before. The internal pterygoid becomese specially developed, and its point of origin, the pterygoid fossa, becomes much enlarged. The border of the angle of the mandible becomes more or less inflected. In their effect on the move-

ments of the ramus they oppose that of the temporal muscle, since they draw the ramus forwards. They are the effective muscles in the use of the incisor teeth, that is, in the opposition of the inferior incisors against the superior, from below and posteriorly. Hence the great development of the internal pterygoid, and, in a less degree, of the masseter. Both muscles tend also to close the jaws, but at a different point in the act of mastication from that at which the temporal acts. If we suppose the mouth to be open, the action of the masseter and internal pterygoid muscles draws the mandible forward and upwards until the incisors have performed their office, or the molars are in contact with each other or with the food. They then relax, and the temporal muscle continues the upward pressure, but draws the ramus backwards to the limit set by the adjacent parts, causing the act of mastication.

A fifth effect of the development of the incisors, and of the propalinal mastication, is seen in the positions of the molar teeth. The indefinitely repeated strain and pressure applied to the superior molars from forwards and below, has evidently caused a gradual extension of the maxillary bone backwards, so that the last molars occupy a position much posterior to that which they do in other orders of mammals. This is especially the case in such forms as Bathyergus, Arvicola and Castoroïdes (Fig. 4), where the last molars are below the temporal fossa, and posterior to the orbit.

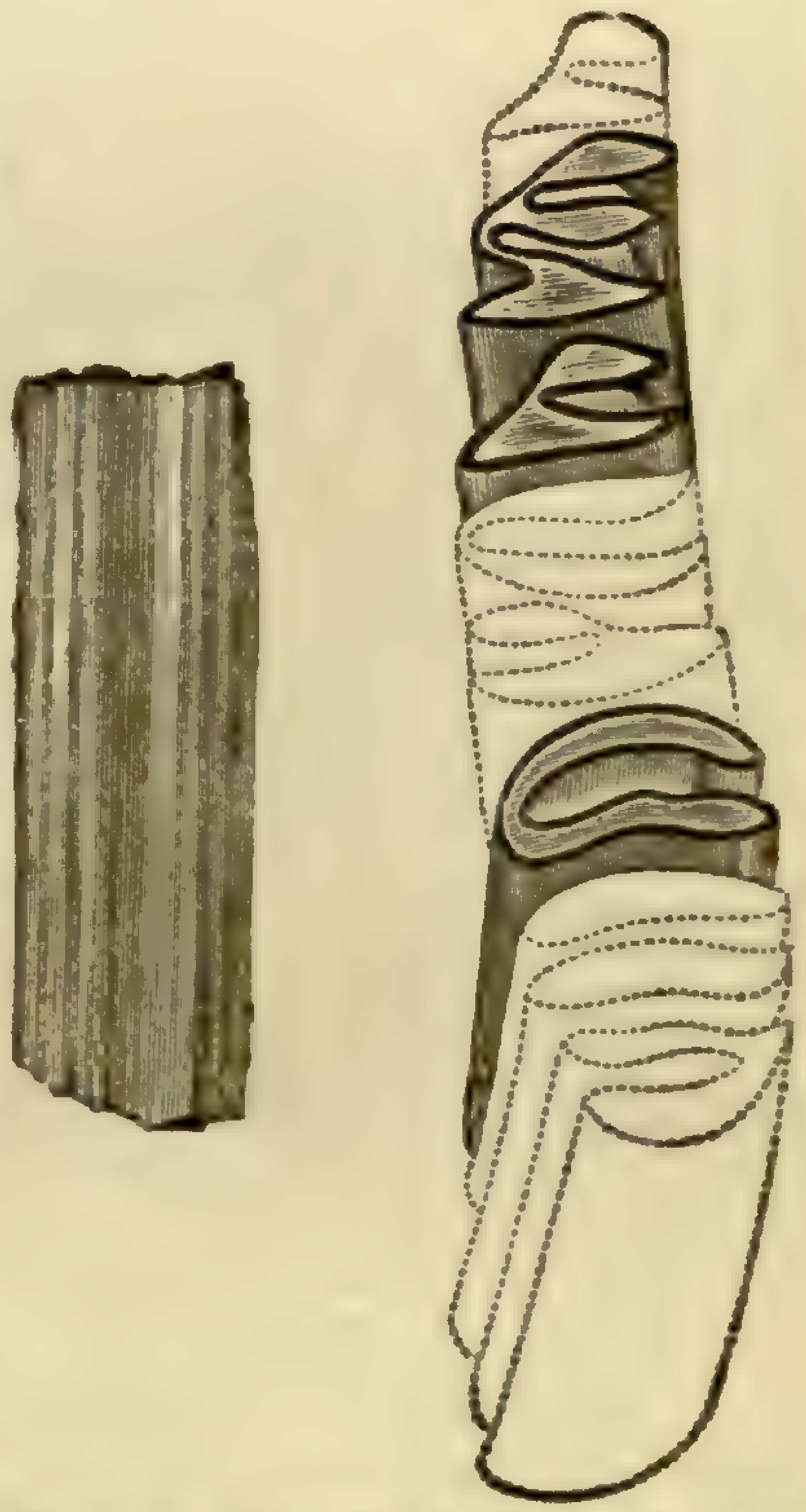

FIG. 6. Teeth of *Hydrochœrus æsopi* Leidy, natural size. From Charleston, S. C. After Leidy. *a*, fragment of superior incisor; *b*, the shaded portions represent parts of inferior molars found.

A sixth effect of the causes mentioned has been referred to by Ryder.[1] This is the oblique direction of the axes of the molar teeth. These directions are opposite in the two jaws; upwards and forward for the lower, and downward and backwards for the upper. The mechanics of this change of direction from vertical in the primitive forms (Sciuridæ) to oblique in the genera with prismatic molars, is simple enough. The inferior crowns, when

[1] Proceed. Acad. Philada., p. 66, Figs. 8, b and f.

closely appressed to the superior, and drawn posteriorly in the direction of the long axis of the jaw, press and strain the teeth in the two directions mentioned. The development of the long prismatic crowns which has proceeded under these circumstances, has been undoubtedly affected by the pressure and strain, and the direction we find has been the result.

The seventh effect is in the detailed structure of the teeth themselves. Beginning with short crowns with simple transverse crests, (Psittacotherium and Sciuridæ, Figs. 1 and 5), we reach, through intermediate forms, crowns with vertical laminæ of enamel, which sometimes divide the crown entirely across (Chinchillidæ, Caviidæ, Castoroididæ), or appear only on the ends of the crown, through the continued coalescence of the prisms of which each molar crown is composed (Arvicola). In many instances the crowns increase in transverse at the expense of their longitudinal diameter (Castor, Lepus). The vertically laminated structure is evidently due to the crowding together of transverse crests by the same pressure which has given the crowns their oblique direction. In many genera the lengthening of the crown has included the lengthening of the longitudinal connection between the transverse crests, as in Arvicola, Castor and Hystricidæ generally. In others this connection has not been continued, so that the crown is composed of prisms which are separate to near the base, as in Amblyrhiza and Saccomyidæ. In others, connection between the prisms has been lost by cœnogeny, as in Chinchillidæ and Caviidæ generally. The latter families display also the greatest amount of crowding (Fig. 6).

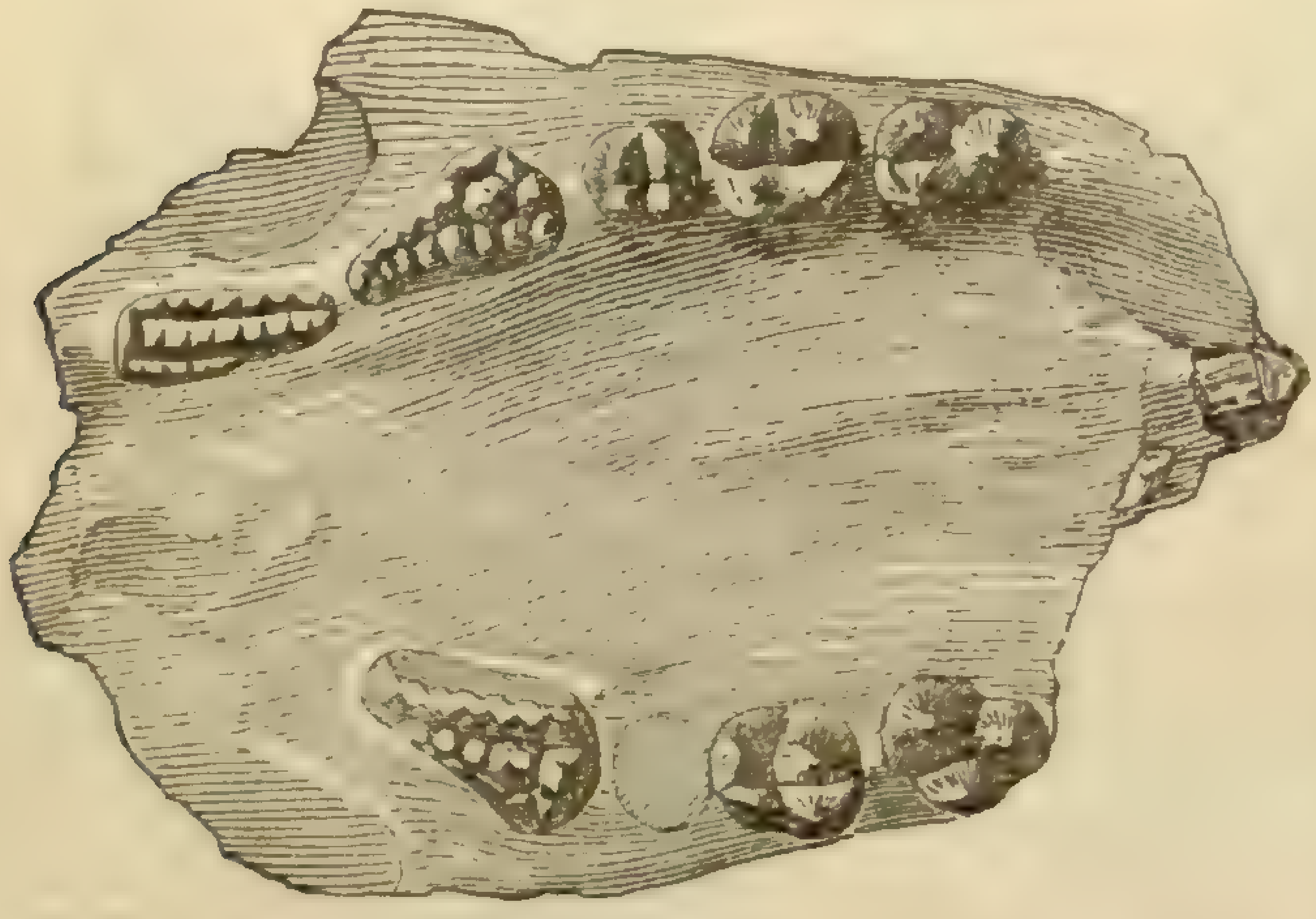

FIG. 7. *Chirox plicatus* Cope, palate and molar teeth from below, three-halves natural size. From Puerco bed of New Mexico. From American Naturalist, 1887, p. 566.

A peculiarity of the plication of rodent molars I am unable to explain as yet on mechanical principles. In genera which are isognathous, the inflections are of equal depth on opposite sides of both superior and inferior molars. In anisognathous genera

the inflections are more numerous and profound on opposite sides of the molars of the respective jaws. Anisognathism in rodents is generally, as shown by Ryder, of the type where the inferior molars include a wider expanse than the superior, though this

FIG. 8. *Polymastodon taöensis* Cope, jaws, two-thirds natural size, from Puerco bed of New Mexico. Figs. *a-d*, lower jaw; *e*, upper jaw. Original.

applies in some instances more to the direction of the roots rather than the position of the crowns. In Lepus the lower jaw is the narrower. The two types of anisognathism may be termed hypanisognathism (Lepus, Diplarthra) and epanisognathism (Caviidæ). The following genera display these characters :—

Hypanisognathous.	*Isognathous.*	*Epanisognathous.*
Lepus.	Arvicola.	Hystricidæ.
	Capromys.	Castor.
		Caviidæ.

In conclusion I will say that it is satisfactorily proven to my mind that nearly all of the peculiarities of the Rodent dental system, and manner of mastication, are the mechanical consequences of an increase in the length of the incisor teeth. And the increase in the length of these teeth has been due to their continued use, as believed by Ryder.

Note on the Marsupialia Multituberculata.—The structure of the dentition of this suborder is in many respects like that of the Rodentia in the known forms. The incisors in the Plagiaulacidæ, Chirogidæ and Polymastodontidæ have structure and functions generally similar to those of the Rodentia. The result in the form and function of the molar dentition has been similar to that observed in the Rodentia. The postglenoid process is probably absent in these animals; in any case the mandible, or condyle, is rounded and is not transverse. Professor H. F. Osborn has pointed out to me that mastication was performed by a fore and aft movement of the inferior molars on the superior, in Plagiaulacidæ. This was no doubt the case in the other families named. The resulting structure of the crowns is, however, different, and needs explanation. The molar teeth present conical tubercles in longitudinal series, two in the lower, and three in the upper jaw. The two series of the lower jaw alternate with the three in the upper jaw, moving in the grooves between the latter, while the three series of the upper molars reciprocally embrace the two of the lower molars. This is demonstrated by the mutual wear of the tubercles seen in Ptilodus and Chirox (Fig. 7). The trituration was probably the same in Tritylodon, but in Polymastodon the increased thickening of the tubercles prevented their interlocking action in mastication. In this genus the tubercles slid over each other, and truncated the apices until in old specimens they were entirely worn away (Fig. 8 *c e*). In Meniscoëssus and Stereognathus we have an interesting illustration of the effect of the action of cusps on each other when under prolonged mutual lateral thrust. Their external sides have been drawn out into long angles in the direction of thrust, converting their transverse sections from circles to crescents. As the thrust is in the longitudinal Multituberculata, the crescents are

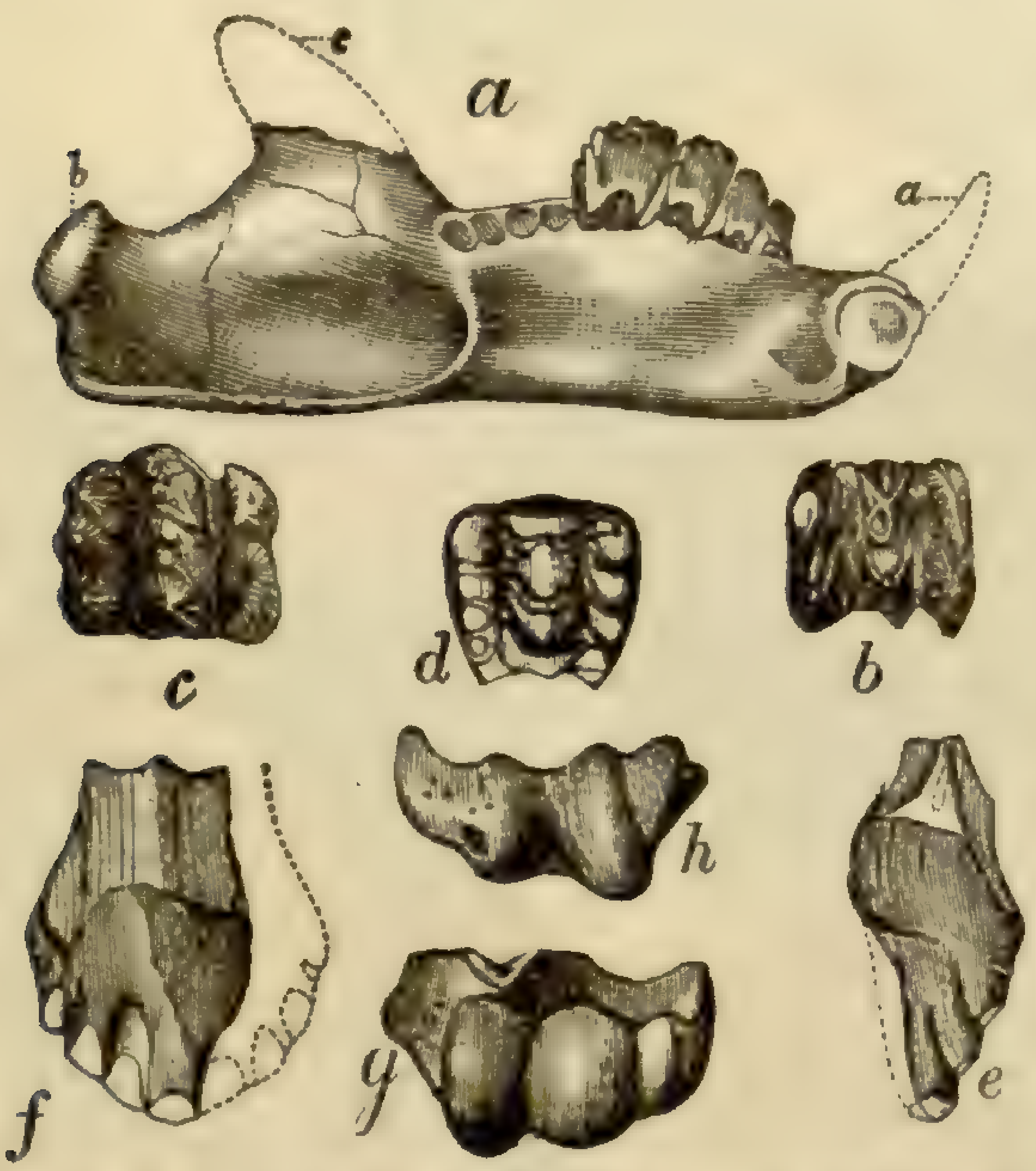

Fig. 9. Marsupialia Multituberculata. Fig. *a*, *Ctenacodon serratus* Marsh, $\frac{3}{1}$ from Marsh; *d*, *Meniscoëssus conquistus* Cope three-halves natural size; *b*, superior molar; *g e*, humeral condyles; *f h*, premolar. Fig. *d*, *Stereognathus oöliticus* Owen $\frac{3}{1}$, from Owen; *c*, *Tritylodon longaevus* Owen $\frac{3}{1}$, from Owen.

PLATE I.

Fig. 1. Podophrya compressa, with three captured Amœba. Fig. 2. Unusually large individual. Figs. 3-11. Various phases in reproductive process. Fig. 12. Animal as it appears in side view.

transverse to the axis of the jaw. In the selenodont Diplarthra, where the thrust is transverse to the line of the jaw, the crescents are longitudinal. That similar effects should accompany similar movements in two groups of Mammalia so widely separated as these two, is strong evidence in favor of the belief that the two facts stand in the relation of cause and effect (Fig. 9, Figs. *b* and *d*).

DESCRIPTION OF A SUPPOSED NEW SPECIES OF ACINETAN, WITH OBSERVATIONS ON ITS MANNER OF FOOD INGESTION AND REPRODUCTION.

BY C. C. NUTTING.

PODOPHRYA COMPRESSA Nutting.

DESCRIPTION :—Body illoricate, quadrate, wider anteriorly; length from two to five times the greatest width; compressed, about three times as wide as thick; the anterolateral corners occupied by rounded prominences, each bearing a fascicle of many suctorial tentacles which, when fully extended, are more than half the length of the body, and spiral or spirally marked when retracted; posterior portion of body rapidly narrowing to meet the very short thick pedicle which is furnished with a sucking disk at its distal end; parenchyma densely and evenly granular; contractile vacuole single, anterior; endoplast oval.

Length of body, 1–277″ to 1–140″.

Habitat. Fresh water.

The above-described species has recently been numerous in a fresh-water aquarium in the Biological Laboratory of the State University of Iowa, where it was first noticed by Professor S. Calvin, who kindly delegated its investigation and description to the writer.

In general appearance it somewhat resembles certain species of the genus *Acineta*, but the absence of any indication of a lorica excludes it from that group, and it is hence, with some doubt, placed in the genus *Podophrya*, with which it agrees in possessing distinctly capitate, fasciculated, suctorial tentacles only. It is

more like *P. buckii* than any other species heretofore described, but differs from it in possessing a distinctly compressed instead of cylindrical body, and in having a distinct, though short and thick pedicle.

Whether this is a new species or not, the observations made on its food ingestion and reproduction are, perhaps, of sufficient interest to justify publication.

Although in two instances this animal was observed to capture ciliated Infusorians, its preference is decidedly for the Amœba, which are abundant in the aquarium referred to. No sooner does an Amœba come within reach of the long suctorial tentacles of the Acinetan than the dish-shaped suckers fasten firmly on their prey and draw it nearer to the body of the captor. On some occasions the capture and subsequent ingestion were observed to be effected by one tentacle only, while on others many were employed in the operation. In one instance three Amœba were held and ingested at once (Fig. 1).

The ectosarc is soon punctured, *how* we could not discover, and almost immediately the body of the Amœba begins to decrease in size, its rounded outlines disappear, and in a short time after the capture it is reduced to a shapeless mass of flat and wrinkled ectosarc, the endosarc having been completely sucked away with the exception of the remains of diatoms and other objects too large to be drawn through the tentacular canal. The investment of ectosarc is then discarded, and the tentacles withdrawn and made ready for other victims.

The above observations were made with a one-fifth objective. A one-twelfth immersion objective yielded still more interesting and instructive results. As good fortune would have it, the Acinetan under observation almost immediately captured two Amœba. One was caught at first by one tentacle only, which was then partially retracted, when several other tentacles curved around and grasped the prey in a close embrace, at the same time applying their several suckers, which seemed to be pressed out flat against the outside of the Amœba. In a few seconds the ectosarc was pierced, when suddenly a rapid stream of granular protoplasm was seen flowing down the interior of the tentacles and into the body of the captor. So strong was this current that the particles flowing through the tentacles were forced in a rapid stream some distance into the parenchyma of the Acinetan, while in the body

of the Amœba the suction was so strong that particles were seen to rapidly converge from all directions to the points where the suckers were applied.

After exhausting the contents of the Amœba, one of the tentacles was seen to *violently eject a stream of granular protoplasm.* This was twice repeated, but the last time the act followed a slight pressure on the cover glass. On no other occasion was this ejection observed, but the query at once arises—Are these suctorial tentacles at times excretory in function?

This seems hardly credible in view of Huxley's statement, "Solid food is not ingested through these tentacles" (Anatomy of Invertebrated Animals, Am. Ed., p. 94), but a subsequent observation removed this difficulty. On this latter occasion a Ciliated Infusorian rapidly crossing the field came in contact with one or more of the extended tentacles of the Acinetan, which immediately grasped the victim, and held it in spite of its violent struggles. Four incisions were made in the ectosarc of the prey, and soon four rapid streams of protoplasm were passing into the body of the captor, rapidly exhausting the endosarc of the Infusorian, although its cilia continued in motion long after the animal was reduced to a mere fraction of its former proportions. During this process *solid colored granules* were seen to pass from the body of the victim through the tentacles and into the body of the Acinetan. This observation was verified upon at least one other occasion.

The ingestion of solid food would seem to render an excretory organ necessary to the Acinetan, and if this is so it seems at least possible that the suctorial tentacles may serve the purpose.

In regard to the manner of ingestion of food by the Suctoria, several of the leading authorities, including Maupas and Kent, hold that there is a double current of protoplasm in the tentacle, one of granular protoplasm passing into the body of the Acinetan, and another of colorless sarcode passing in an opposite direction. The writer has failed to find any evidence of the latter current, although his purely negative testimony is of little weight. Still the question might be pertinently asked: Why does not this colorless stream, pouring into the body of the victim, produce a current among the protoplasmic granules of the latter, which is directed *away* from the distal extremity of the suctorial tentacle? A number of observations under favorable circumstances failed to disclose the existence of any such currents, although strong currents toward the point of incision were always distinctly seen.

The structure of the suctorial tentacles, as described by Kent, is that of a hollow tube traversed internally or externally by a spiral filament or granular crest, which appears as transverse striæ when the organ is fully retracted. The writer has in vain attempted to assure himself of the correctness of this view as regards the species under consideration. It may be that a higher magnification would reveal the structure above alluded to, but a one-twelfth immersion objective[1] used under favorable conditions of light, etc., and repeated observations have shown what seems to be merely a *coiling and uncoiling of the entire tentacle,* without any indication of the large central core figured in Plate xlviii., fig. 22, of Kent's Manual of the Infusoria. The extension and retracting of the tentacle appears to be effected by the uncoiling and recoiling of the whole organ.

In working out the method of reproduction of this species, the writer was at first entirely misled by discovering a specimen with embryos clustered around its anterior end as represented in fig. 4. The resemblance of this to the exogenous gemmation said to be common in the genus *Hemiophrya,* at least, and figured in Plate xlvii., fig. 8, Kent's Manual of Infusoria, was so striking that there seemed hardly a doubt as to the interpretation ; and had no more observations been practicable, the species would have been described as reproducing by exogenous gemmation. The question naturally arises: May not others have been misled in a similar way, and may not exogenous gemmation be much more rare among the Suctoria than has been commonly supposed?

The life history of this Acinetan discloses the following stages, several of which merge almost insensibly into each other:

1st. The parent form suffers the loss of its suctorial tentacles, which seem to shrivel up and gradually disappear. Fig. 3.

2d. Internal embryos of a round or oval shape make their appearance in considerable numbers in the endosarc of the animal. Fig. 3. This process is accompanied and preceded by an unwonted activity in the granular protoplasm of the parent.

3d. These embryos escape through the anterior portion of the

[1] Since writing the above, satisfactory observations have been made with a magnifying power of 1600 diameters, which have confirmed the view here advanced. Indeed there seems no room for doubt so far as the present species is concerned, whatever may be the facts in regard to others.

ectosarc of the parent, but remain for some time just outside of the latter, and apparently attached to it either by a sort of plasma or by short stalks. Fig. 4.

4th. The embryos develop cilia and swim away as free, ciliated embryos. Fig. 5.

5th. The ciliated embryos become fixed to some object and acquire a triangular shape and a few (three or four) suctorial tentacles at each antero-lateral angle. At about this time the single anterior contractile vacuole appears. Fig. 6.

6th. The animal now grows longer, and gradually acquires more suctorial tentacles until the adult form is reached. The development is illustrated in figs. 7, 8, 9, 10, 11, none of which are hypothetical, each having been observed by the writer.

Fig. 2. represents an individual of nearly twice the ordinary length, showing two transverse constrictions or markings of the ectosarc. In this, as in most other specimens examined, the animal is largely obscured by various objects, which seem to adhere to its surface as if it were covered by a viscid substance.

AN INQUIRY INTO THE STATE OF EARTH'S INTERIOR.

BY IRA SAYLES.[1]

THERE seems to be a strangely broad difference between the conclusions of the geologists and the physicists on the condition of Earth's interior. This broad difference, therefore, invites every thinker to think for himself, and to conclude as best he may be able. As a thinker I enter the lists.

It is manifest, from a bare inspection of the question at issue, that it demands both the inductive and deductive processes of ratiocination. Inductively, the fact of heat must be established, its extent established, and its persistence established: deductively must its maximum be reached, it effects be reached, and the main results of these effects be reached.

[1] U. S. Geological Survey.

The geologist observes the lines of volcanoes girdling the earth as it is, and concludes that *there must be a very extensive ocean of molten matter beneath Earth's crust,* to say the least.

He turns his attention to the great continents with their mountain ranges, high plateaus and low broad valleys, and finds a somewhat astonishing degree of instability everywhere. Upheavals and submergences are everywhere in progress. From these signs he argues, and that rightly, that *there must be a translation of matter from point to point beneath the surface.*

This, he further argues, is consistent with fluidity only. A very legitimate conclusion surely.

He takes another line of observations. He descends into the crust of the earth, and everywhere finds *the temperature augmenting as he descends.* Though this augmentation is constant, the rate of increment is not in all places the same. Still, however, this universal fact of increase of heat points straight to one conclusion, and corroborates the conclusion drawn from volcanoes, elevations or upheavals and submergences, viz., *the temperature of liquefaction must be reached.* All known rocks must become fluid.

He turns to the record Earth has kept of her past history. There he finds that, in all geologic history, upheavals and submergences have been common everywhere. He finds volcanoes have always existed. Moreover, he finds that great gaping rents have lacerated Earth's adamantine bosom, and that through these huge rents vast streams of molten matter from the interior have gushed out over land and into ocean, spreading devastation wherever it flowed.

He now discovers that this molten condition of the interior has remained a persistent fact from the very earliest geological eras—undetermined millions of Earth's years—*millions,* not thousands. Millenniums are but days in this great record. *Interior heat has, therefore, been a persistent fact, and a persistent factor in geologic dynamics.*

Moreover, these facts of upheaval and submergence, being universal, declare the universal fluidity of the great Earth-heart within. It is no circumscribed lake, as suggested by some. *It is one universal mass of excessively high temperature.*

When, however, the geologist concludes that fluidity will be reached at about the point indicated by his observed rate of augmentation of temperature, along a descending line, his con-

clusion is a *nonsequitur,* because he fails to recognize the changed conditions. As the line descends, *pressure increases directly as the line lengthens.* Now, one class of physicists claim that the increment of pressure is persistently superior to the increment of heat but these physicists fail to notice that, when high temperature and high pressure are simultaneously exerted on the same rock, the character of the rock is changed, so that *it becomes a far higher conductor of heat;* and that, therefore, *the incremental ratio for the heat very far exceeds the increment of pressure.* Hence fluidity is assured; but, this point once reached, another law comes in, viz.: *The conduction and interstitial radiation become extremely rapid through the fluid mass, so that the temperature of the fluid is uniform with the temperature of the entire nucleus,* and therefore *no further augmentation can take place;* but the ratio of pressure augmentation does not change. So that the increasing pressure soon overtakes the expanding power of the maximum heat, passes its limits, and solidifies all the nucleus within this limit.

An ideal section through the Earth's centre will, therefore, show the following:

First, an outer solid envelope.

Second, a semifluid envelope.

Third, a fluid envelope.

Fourth, a semifluid envelope.

Fifth, a solid nucleus.

No. 1 results from reduced temperature alone.

No. 2 results from pressure and a temperature not quite sufficient for liquefaction.

No. 3 results from a temperature sufficiently high to liquefy it under high pressure, and *is the maximum temperature.*

No. 4 results from the increase of pressure so as to be just overtaking the expansive power of the maximum temperature.

No. 5 results from a pressure so high as to overcome, completely, the expansive power of Earth's *maximum heat.*

At the centre of Earth the pressure, taking her general average, 5½, water being unity, is 7,180,593,750 lbs. to the square foot—a pressure so enormous that no known substance could fuse beneath it at Earth's maximum temperature. Even hydrogen would be as hard as diamond at this maximum temperature of the internal nucleus.

In the foregoing I decline to fix the limits to any one of the five regions of the section, and content myself with showing that they must all find a place, and in precisely the order named, and for the reasons named.

All the above is strictly in accordance with observed facts, and as strictly in accordance with the laws of heat under pressure, both acting on the same matter at the same time.

I have strictly refrained from special theories, and thereby have avoided personalities.

SOURCES OF EARTH'S INTERNAL HEAT.

First. The source of the primary heat of this internal mass was the arrestment of the cosmic motion of the atoms, by centralization under the laws of gravity and rotary motion of the mass about Earth's axis. The free descent along the line of the axis must have resulted in an exceedingly high motion, and this motion was arrested at the centre, and in the growing nucleus, forming by their union.

Second. The heat, thus evolved, initiated chemical action among these atoms thus rushing in. These were the sources of the original nuclear heat.

When the mass was solidified, the heat was so high that very many of the superficial elements existed in their gaseous state only, forming an envelope around the central heated mass.

Finally, when this central mass had so far lost its fiery energy as to permit their descent in a liquid state, they descended in the order of their respective heat-endurance. Now, in their turn, they began to solidify, and form the outer crust.

Last of all, when the outer coating of this outer crust had reached the proper temperature, the water began to condense on the tops of all jutting peaks. Chemical action again set in as this water reached the alkine minerals. Here was another accession of heat.

In due time Earth became productive of living organisms. Water began to tear down the incipient mountain ridges, carry the debris down into the young ocean, and there form the sedimentary rocks. The thin crust frequently bent beneath their accumulating weight, and brought these half-formed rocks within the influence of this internal heat. Chemical action again, to a greater or less degree, modified them, and they were hardened into rocks.

Finally, the sun burst through the primeval shroud, or swaddlings of the new-born Earth, and began to lend its heat, to warm up the tender young bosom of Earth, and to fecundate her developing powers. Ever since that beginning, the sun has not failed for an instant, to pour in his genial warmth over some portion of Earth's surface. This warmth, in the form of organic bodies, has constantly been sinking into the same surface; and, though we take little note of it, this amounts to a vast quantity, in geologic ages.

I believe the foregoing is a fair summary of the case I undertook to investigate. It is only a summary.

ON SOME INTERESTING DERIVATIONS OF MINERAL NAMES.[1]

BY F. M. ENDLICH.

IN bestowing a name upon any hitherto unknown substance, two factors mainly contribute to determine its character: The circumstances attending the discovery, and the facts which have become known in relation to such substance. The basis upon which the new name has been formed may, in a general way, afford an indication of the scientific standard of its sponsor or of the period during which it became known.

Probably the first thought which the sight of a new mineral, for instance, may occasion, will refer to its geographical origin or physical appearance. The second question might, appropriately, refer to its composition; the third, to special characteristics and to its uses. We find, in point of fact, that a number of minerals were named by

[1] As any dissertation upon a subject like the derivation of mineral names must, of necessity, largely be a compilation, I have refrained from making citations which would uselessly cumber the article. I have principally utilized the publications of Theophrastus, Dioscorides, Pliny, Agricola, Beudant, Cæsius, J. D. Dana, Domeyko, Estner, Gessner, v. Kobell, Linnæus, Matthesius, Naumann, Pape, Quenstedt, Wallerius, Weigand, and Werner, besides various lexicographic and poetical works. The manner in which I have presented the subject is essentially original, and a number of suggestions have been introduced which may throw light upon some doubtful points or furnish hints for further elaboration.—E.

the ancients from the localities whence they were obtained, and this practice has been imitated with pious fervor during the last half century.

While the method of commemorating the name of the place which furnished the first specimens of any given species has certain advantages, philological as well as mnemonic, the nomenclature may thereby be rendered somewhat unwieldy, as *Nertschinskite, Herrengrundite, Guanajuatite,* and many others can testify. Similar in causal origin, but admixed with a certain spirit of appreciative courtesy, are those names which are derived from individual patronymics. Many scientific men, discoverers of new compounds, friends of mineralogists and chemists, and some persons of political rather than scientific prominence, have been immortalized by the bestowal of their names upon sound mineral species. Convenient and graceful as this mode of recognizing the services or merits of others may be, it is open to the same objections that apply to the use of geographical names, in that the burden of carrying words like *Macfarlanite, Schwarzembergite, Zepharovitchite,* and many others, is nearly as depressing as that imposed by the more recent terminology of organic chemistry.

A system of forming names from some physical characteristic is, perhaps, not more rational than the preceding; but it produces less bizzarre results, is apt to convey valuable hints, and tends to cause a desirable mental association of external features with the word designating the species. Thus, *Antholite,* contr. Gr. ἀνθος, flower, and λιθος, stone; *Asbolite,* der. Gr. ἀσβολη, soot, or *Xanthoconite,* contr. Gr. ξανθος, yellow, and κονις, dust, furnish a brief description of certain leading, immediately apparent individualities of the minerals. Other properties, which may not be patent at first sight, give rise to names like *Graphite,* der. Gr. γραφω, I write; *Heliotrope,* contr. Gr. ἡλιος, sun, and τρεπω, I turn, the name given by Pliny to a variegated jasper, as he found that its red blotches and bands seemed to increase in size and brilliancy when held under water, in the rays of the sun.[1]

A concise review of the most prominent physical attributes of minerals show the following to have influenced the formation of mineral names in a marked degree:

[1] "Causa nominis, quoniam delecta in vas aque fulgorem solis accidentem percussa sanguineo mutat." Pliny, A.D. 70. Venice, 1557.

FORM has produced *Stylotypite,* contr. Gr. *στυλος*, column, and *τυπος*, form; *Diagonite,* der. Gr. *διαγωνως*, angular; and many others.

WEIGHT is indicated by *Barite,* der. Gr. *βαρυς*, heavy; *Tungstite,* contr. Sw. *tung,* heavy, and *sten,* stone; and others.

COLOR is a marked feature, duly recognized by names like *Cyanite,* der. Gr. *κυανος*, sky-blue; *Ruby,* der. L. *rubeus,* red; *Polychroilite,* contr. Gr. *πολυς*, many, *χμοια*, color, and *λιθος*, stone; and many others.

LUSTRE is referred to *Lamprophanite,* contr. Gr. *λαμπςος*, shining, and *φαινω*, I appear; and many others. Light and touch alone will acquaint the observer with the special properties, but further examination will reveal others of equal importance.

STRUCTURE is alluded to by a name like *Fibroferrite,* contr. L. *fibra,* fibre, and *ferrum,* iron; and others.

FRACTURE is referred to in *Scolopsite,* der. Gr. *σκολοψ*, a splinter; and many others.

CLEAVAGE is of value in specific description and identification, as is testified to by names like *Euclasite,* contr. Gr. *εὐ*, well-easily, and *κλαω*, I cleave; *Loxoclase,* contr. Gr. *λοξος*, oblique, and *κλαω*, I cleave; and many others.

ODOR, TASTE, ELECTRICAL, CRYSTALLOGRAPHIC, OPTICAL, and other properties are duly utilized in the formation of distinctive names. After the physical constitution of a substance has been exhausted in furnishing points for discrimination, the most prolific field to turn to is that of chemical exploration. Under the application simply of heat, many minerals are curiously transformed. Often the changes exhibited are highly characteristic, and can well be utilized for taxonomic purposes. *Scolecite,* der. Gr. *σκωληξ*, a worm, describes a mineral which exfoliates into contorted, worm-like forms upon heating; *Melanophlogite,* contr. Gr. *μελας*, black and *φλογιστος*, burned, refers to a marked change of color under the influence of heat; *Zeolite,* der. Gr. *ζεω*, I boil, designates an important group of allied minerals which bubble and intumesce upon fusion; *Euosmite,* contr. Gr. *εὐ*, well, agreeable, and *ὀσμη* odor, is the name of a species which emits a pleasant odor when heated, contrary to the general rule.

The chemical composition of a mineral is of the highest importance, and valuable hints as to its nature can be conveyed by the

name. *Stercorite*, der. L. *stercus*, manure; *Arseniosiderite*, contr. Gr. *ἀρσενικον*, arsenic, and *σιδηρος*, iron, and many others, convey useful information as to component parts. Every now and then the investigator finds himself somewhat baffled by the constitution of the mineral, or he obtains unforeseen results. Nordenskiöld met a case of this kind by coining the name *Thaumasite*, der. Gr. *θαυμαζω*, I am surprised; and Ekeberg by forming *Automolite*, der. Gr. *αὐτομολος*, deserter, in allusion to the fact that his specimen had deserted other species to which its composition was supposed to be allied. *Æschynite*, der. Gr. *αἰσχυνη*, shame, records Berzelius' protest against the inability of chemical science of that day (1828) to separate zirconic and titanic oxides. Peculiarities in chemical behaviour also find expression in the name: *Tachhydrite*, contr. Gr. *ταχυς*, quickly, and *ὑδωρ*, water, refers to the rapid deliquescence of the substance upon exposure to the air.

In some instances both physical and chemical properties which are especially noticeable, may be indicated by the name: *Sideroschisolite*, contr. Gr. *σιδηρος*, iron, *σχισιος*, split, and *λιθος*, stone, is the name of a ferric silicate with perfect cleavage; *Chalcophyllite*, contr. Gr. *χαλκος*, copper, and *φυλλον*, leaf, alludes to the foliated structure of a cupriferous mineral.

The Greek language, singularly flexible and rich in clear definitions, has furnished the majority of descriptive mineral names; Latin has been used more sparingly. Examples are not wanting where Greek and Latin have been combined in the same word, although this practice is to be deprecated: *Pyraurite*, contr. Gr. *πυρ*, fire, and L. *aurum*, gold ("molten gold"); *Cupraphrite*, contr. L. *cuprum*, copper, and Gr. *'αφρος*, foam, is a literal rendition of the prior G. *Kupferschaum*. Languages of our own day have likewise yielded their quota to the list of mineral names: *Muromontite*, contr. L. *murus*, wall, and *mons*, mountain, is the Latinized form of G. *Mauersberg*, where the mineral was found; *Leucopetrite*, contr. Gr. *λευκος*, white, and *πετρα*, cliff, translates the G. *Weissenfels*. The G. *Olivenerz* of Werner, 1789, has become *Olivenite*, on account of its color (G. *Olivin*), and the popular term of *Carminespar* has evolved into *Carminite*.

The successful attainment of uniformity in mineralogical nomenclature is largely due to the rigid stand taken by Professor James D. Dana, the eminent American mineralogist. But a few centuries since, all matters pertaining to chemistry and mineralogy were in the

hands of alchemists, apothecaries, and a few doctors of medicine. For the production and application of meaningless names, these gentlemen are to be commended. The principal metals were called by the names of the "heavenly bodies," as Chaucer has rhymed it:

> "Sol gold is, and Luna silver we threpe;
> Mars iren, Mercurie quicksilver we clepe."

Others were endowed with terms like *lupus metallorum*, wolf among metals, for *antimony; diabolus metallorum*, the devil among metals, for *tin; spuma lupi*, wolf's spittle, for *wolfram*, etc. On the other hand, we are indebted to the alchemists for many chemical terms which are now indispensible—*e.g.*, *alcohol, alkali, crucible*, and many others. The influence of ancient Arabic magic and occult science is plainly discernible in the Oriental source whence the alchemists chose their names for various 'substances. By so doing they removed the comprehension of their terminology far beyond the reach of laymen, and even of many learned philologists and ecclesiastics, and added to the attractive mystery which enveloped their labors. Linnæus, about 1730 to 1740, attempted to introduce binomial nomenclature for minerals; but the science was not ripe for it in his day. His efforts were in the right direction, tending, as they did, towards systematic classification; but the means were not at his hand to use proper discrimination. The material was too crude; the analytical knowledge too insignificant. To-day some of his names cause a smile—*e.g.* (Edition Gmelin, 1773), his genus *Silex* contains the species *Silex achates*, agate, and the subspecies *Achates arenomorphos*, "with drawings of constellations;" *A. zoomorphos*, "with drawings of animals;" *A. tecknomorphos*, "with drawings which the imagination transmutes into works of art," etc.

Few of the mineral names given by the alchemists have survived in their original application, but their researches have enriched our fund of available words. Quicksilver (*mercurius vivus*) has been handed down unchanged; but *Marcasite*, for instance, now designates a compound of sulphur and iron, while it was used for bismuth (*marcasita argentea*) originally. Besides the planets, mythological deities have been called upon to furnish names for the ever-growing list of mineral compounds. *Thorite* perpetuates the name of the mighty Scandinavian god, the son of all-powerful Odin and the Earth.

In addition to the features which have been touched upon above, as affording especially noticeable suggestions for the construction of mineral names, there are a few others of sufficient prominence to command attention.

MODE OF OCCURRENCE is often associated with the genesis of the substance; hence of importance. *Limnite*, der. Gr. *λιμνη*, marsh,, alludes to the origin and formation of *bog-ore*. *Alunogen*, a curious cross between Fr. *alun*, alum, and Gr. *γενναω*, I produce, refers to the generation of the mineral from decomposing *Pyrite*.

RESEMBLANCE to other species may provoke errors of identification, and gives rise to names like Apatite, der. Gr. *ἀπαταω*, I deceive, on account of its resemblance to *Aquamarine*.

COMPARISON with allied compounds is expressed in names like *Miargyrite*, contr. Gr. *μειων*, less, and *ἀργυρος*, silver, whereby the fact is indicated that this mineral carries less silver than other closely related species.

MIMICRY of natural objects is readily perceived and made the basis for a name. Thus, *Ophite*, der. Gr. *ὀφιτης*, snake, is applied to some varieties of *Serpentine* (snake-stone) because of snake-like markings. *Botryogen*, contr. Gr. *βοτρυς*, a bunch of grapes, and *γενναω*, I produce, explains itself.

DECEPTION is recognized in minerals whose occurrence or genesis would lead to the inference of a different composition than they possess in reality. *Sphalerite*, der. Gr. *σφαλερος*, treacherous, was so named because it carried very little silver, though generally associated with argentiferous ores.

THE USES to which a mineral may be put also furnish hints for its name. *Agalmatolite*, contr. Gr. *ἀγαλμα*, picture, and *λιθος*, stone, is the material utilized by the Chinese in carving out numerous small objects.

A rather pathetic appeal reaches us through the name of one of Breithaupt's species: *Monacite*, der. Gr. *μοναζω*, I am alone. It is of very rare occurrence.

Apart from the mineral names which have been formed for the purpose of expressing a definite idea, there are some which are of interest on account of their origin, their philological relations, or their application; others claim attention by virtue of the mutations they have undergone, or by their associations.

1. A few names are of obscure origin, and their etymology is imperfect:

Zincite.—The O. H. G. form of *zincho, zinco,* may, perhaps, be perpetuated in the M. H. G. *zinck* (Weigand) and H. G. *Zink,* Sw. *zink. Zincho* signifies a white spot in the eye. The origin of the word is by no means clear, but is probably German or Indo-German. Apparently it is related to G. *Zinn.* (See *Stannite.*)

The metal zinc seems to have been first described by Paracelsus, about 1528. N. L. *zincum.*

Quartz, the name of the most widely-distributed of all minerals, suddenly appears in M. H. G. as *quarz,* with a plural *querze* which latter it retains until the middle of the sixteenth century N. L. *quarzum* (Agricola, 1546); *quartzum* (Wallerius, 1747). No older root seems to be known. G. *Warze, Gewarz,* warty excrescence, has been suggested. The form *Quertz* occurs as late as 1743 (Bergwerck's *Lexicon*), and *Quärtzel* at that time signified a chip of rock, or one which flew into the miner's eye. The word probably originated among German miners, as the mineral is one which might readily escape special notice, unless encountered in the form of veins. *Quartz-crystals* were known as *Kristalle* in M. H. G.

It seems possible that *quartz* should be related to Engl. *quarry,* to L. *quadrus,* G. *quader,* Sw. *quatersten,* and other words pertaining to the cutting of blocks of stone—*e.g.,* L. *quadratarius,* stone-cutter.

M. and N. L. *quartatio,* separation of precious metals from other minerals, might have been corrupted into *quarts* or *quartz,* in allusion to the fact that quartz, when it forms the matrix, generally admits of a sharp definition of "ore" or "metal" and "stone."

Antimony.—It is a difficult matter to trace the origin of this word satisfactorily. We know that the classical Greeks and other ancient nations possessed the antimonial sulphide (*Stibnite*), which was extensively used for cosmetic purposes. The substance was powdered and applied to eyelids, eyebrows, and underneath the eyes, with the intention of making the latter seem larger and more brilliant. This classical custom has survived to the present time.

By the Greeks the word στιμμι, or στιβι, was used to designate the mineral employed. The word is not of Greek origin; possibly Egyptian, probably Arabic. From this the Romans borrowed *stibnum,* which has remained the Latin name of the metallic element to this day. Metallic antimony, though known to the ancients, was

first described, as to its properties, by Basil Valentine, near the year 1400.

Antimony, as a word, fails to comply with the Gr. *στιμμι* in all but the *tim.* That this should be sufficient to establish a connection cannot be claimed, but it indicates that both names may well have a common origin. It is possible that the first syllable, *an,* may be a modification of the Ar. article *al,* in which case the reference of the word to an Arabic origin would seem justified. An old Arabic name for *Stibnite* is *al-kohl* (whence our *alcohol*); but as this seems to refer to the powder, rather than to the crude mineral or metal, there may have been another root. The Ar. *al-ithmidun* is regarded as the source of antimony, the latter being a rather exaggerated corruption of the former. Another derivation brings it from the Ar. *athimar,* the name of the metal. (Const. Africanus, 1100.)

A forced derivation is obtained from Gr. *ἀντι,* against, and M. L. *monachos,* monks. Basil Valentin, the monk, fed some antimonial compound to his pigs, and they grew fat upon it. He tried the same dose upon his cloister brethren, and they died: hence the supposed origin of the name. It remains a coïncident that the French word for antimony introduces an *i* in *antimoine,* and that Fr. *moine* means monk.

Bismuth.—The origin of this word is not very clear. It was first used in Germany in the later middle ages. A common explanation assigns it to O. H. G. *wesemot,* contr. *wese,* meadow, and *mot,* damp ground, swamp; but, aside from the similarity of sound, there seems to be no relation between the two words.

Another root has been claimed in the H. G. word *Wiese,* meadow, as some old writers claim that the colors which the metal assumes upon cooling after fusion are varied and beautiful as those of flowers on a meadow (sixteenth century). The metal is white, and often assumes iridescent colors after melting.

During the sixteenth century German writers speak of it as *Bismut, Bissmuth, Wyssmuth,* and *Wissmuth.* At the same period its Latin name was *bisemutum* (Agricola, 1546). This latter may be merely an amplification of the German term, or it may be composed of the L. words *bis,* twice, and *emuto,* I change, in allusion to the crystalline and color changes undergone upon fusion. About 1400 the word was *bismuthum.*

A more plausible explanation of its origin lies in the derivation from M. H. G. *wiss* or *wyss,* white, the color of the metal. There

are traces of an O. G. root *mut*, which refers to ground, earth, and, in Swedish, seems to indicate ore, mine. From this root the second syllable of the word may be derived. If the name was given by miners—and there is every reason to suppose that it was—then it was, in all probability, a descriptive term, denoting either appearance or some peculiar property. The above derivation would, therefore, determine the meaning of the word as *white-ore*, or some kindred term. Sw. *vismut;* later, *bismut.* The change from *w* or *v* to initial *b* is due to Latinization.

2. Besides the names of decidedly dark origin, there are some which have changed considerably, in their journeys from nation to nation, through the course of centuries. It is interesting to note in these, as well as in other instances, that the words have generally reached Scandinavia through Germany, England through France.

EMERALD is the modified form of Sansk. *marakata* and *samaraka.* In Pers. the latter becomes *zamarrad;* in Ar., *zamamth;* in Gr., μαραγθος and σμαραγδος, with the verb σμαραγδειν L., *lucere,* to shine brightly. In all of these forms, as well as in the L. *smaragdus,* the initial *s*-sound and the final *d*-sound have been preserved.

The Gr. and L. form has persisted in the G. and Sw. *Smaragd;* in It. it is changed to *esmeraldo;* Sp., to *esmeralda.* O. Fr. retained the prefixed *e* and the *l*, using the word *esmeraulde;* subsequently this was modified into *emeraude.* Our English name follows the latter closely in O. Engl. *emeraud* and *emeraulde,* but has retained the *l* in *emerald:*

> . . . . "the semes echon
> Was set with emerauds one and one."
>
> —*Chaucer*, 1340–1400.

and, later:

> "Would emulate the emeraulde-like grass."
>
> —*Stirling*, 1614.

Σμαραγθος was mentioned by Herodotos, about 450 B.C. Usually the name was applied to varieties of aquamarine, rather than to the emerald, although the ancients were familiar with the latter.

> . . . . . . "σμαραγδου λιθου λαμποντος τας νυκτας μεγαθος."
>
> —*Herodotos*, II, 446.

Pliny describes it as surpassing everything that exhibited green color in the loveliness of its shade.

Emery, although so near *emerald* in sound, has a totally different origin. Its Gr. ancestor is *ϐμυρις* or *ϐμηρις*, der. Gr. *ϐμυριζειν*, to polish by rubbing. Dioscorides uses *ϐμιρις*.

In H. G. the word resembles the Greek phonetically—*Schmirgel*, *Schmergel*, or *Smirgel;* Sw. *smergel*. In It. the L. *smiris* changed to *smeriglio;* N. L., *smeriglo* (1602), *smeriglius*, *smirillus* (1610); Sp., *esmeril;* Fr., *emeril*, later *emeri*—whence Engl. *emery*.

It will be observed that a number of words prefix an *e* in French and Spanish. This is probably due to the use of the respective masculine articles *le* and *el*. Thus, It. *smeriglio* becomes *le smeril*, and subsequently *l'esmeril* or *l'emeril*. In Sp. the article *el* is prefixed and the *l* finally eliminated. Changes of gender are of rather frequent occurrence in the history of mineralogical nomenclature, so that French or Spanish names which show an initial *e* but are now feminine may well have been masculine at some early period.

Calamine has often been accredited to Gr. *χαλαμος*, L. *calamus* reed (Agricola, 1540), a name which might appropriately be given to some varieties on account of their structure. This derivation is all the more seductive, as a genus of plants, *Calamites*, has the same ancestry. The name, however, seems to be due to Gr. *χαδμεια*, L. *cadmia*, G. *Galmei*.

Gr. *χαδμεια*, or *χαθμια*, is used by Dioscorides, about A.D. 30, in writing of a mineral, and was supposed to have been derived from the legendary *Καδμος*, a Phœnician, who came to Greece and first introduced smelting there; later by Pliny and others, in the form of L. *cadmia*.[1] In It. it remained *cadmia*, but in the transition from It. to Sp. and G. the *d* changed to *l*, as is frequently the case, and we find Sp. *calamina*, Fr. *calamine*. Alb. Magnus uses *lapis calaminaris* (1280). G. *calmei* appeared in the beginning of the sixteenth century; not long after, the initial *c* of *calmei* was replaced by the H. G. *g*, producing *galmey* (*Cadmia fossilis*, Gessner, 1565); later, *Galmei;* Sw., *gallmeja* (1750). The name was rather indiscriminately applied as "*Cadmia metallica cinerea*," in the sense of "*ein natürlicher, grawer kobelt*" (a natural grey cobalt), shows (Gessner, 1565).[2]

[1] *Namque; ipse lapis, ex quo fit aes, cadmia vocatur.*"

[2] A. Caesalpinus, Aretinus, 1602, says: "Calaminam, seu lapidem Calaminarem, vulgo, Giallaminam, ... Arabes Climian vocant."

GARNET.—From the color and size of the grains—in which latter form garnets were first found—they were originally compared to the seeds of the pomegranate (*malum granatum*), and received the name *lapis granatus* therefrom (cfr. Magnus, about 1280). L. *granum*, grain, is the root, although *granatus*, having the meaning of grains or seeds, was used by Cato about 200 B.C. In G. this has perpetuated itself as *Granat*, from M. H. G. to the present time; in It., *granato;* Sp., *granate;* Fr., as *grénat.* Transposition of the letters forming Fr. *grénat* furnishes the Engl. *garnet.*

It is curious to note that, while the Engl. compound word *pomegranate* (G. *Granat-apfel*) retains the original relative position of *gr*, this has been changed in Engl. *garnet.*

ORPIMENT is a corruption of L. *auripigmentum*, contr. L. *aurum*, gold, and *pigmentum* (from L. *pingere*, to paint), color, used by Pliny, about A.D. 70. O. H. G. *orgimint*, M. H. G. *orgemint*, *orperment*, *opriment*, *opirment*, prepared the way for H. G. *Operment*, in which the *r* of aurum has been entirely dropped and one inserted after the *p*. Sp. *oropiment*, It., Fr. and Engl. retain the *r* in *orpimento* and *orpiment:*

> "The first spirit quicksilver cleped is,
> The second orpiment."
>
> —*Chaucer*, 1340-1400.

ZIRCON.—The derivation of this name is somewhat peculiar. For many years the Island of Ceylon furnished gems and half gems. Some of the latter were utilized to imitate their more valuable associates. Such were called *jargon* in French.[1] Among them were some colorless crystals, and others of yellow and reddish shades, which turned white and clear under the application of heat. These were especially desirable for the imitation of diamond, and to them the name *jargon* finally attached itself almost exclusively. In the middle of the last century Linnæus describes this mineral under the name of *jargon* in such a manner that its identity can be established. He states (Ed. Gmelin, 1777) that the (presumably German) jewelers' name for reddish jargons which turned colorless in the fire was "*Cerkonier*" (*Cerkon*), and that they exhibited the fire and lustre of the poorer quality of diamonds. In 1783,

[1] Linnæus mentions Fr. *jargon* and It. *sargone*, yellow diamonds—the inferior class—whence the name may have been transferred to the stones which counterfeited the valuable gem."

Werner, the famous mineralogist of Freiberg, produced the name *Zirkon* for this mineral. In ordinary parlance, the *zircon* is known as *jargon* in France to-day, so that the accepted scientific name is to be regarded as a corruption of the popular one.

Jargon, in the above acceptation, means counterfeit, wrong presentment, but the word is now more particularly used in the sense of *gibberish.* The remote origin of jargon may connect it with Gr. *γαργαριζω*, I gargle—make a noise in the throat—and L. *garrio,* chattering (whence Engl. *garrulous*), gossiping. In It. it has changed to *gergone* and *giargone* (de Boot, 1636); Sp., *jerga, jerigonza*; Fr., *jargon*; O. Engl., *jergon*; Engl., *jargon* (der. A.-Sax. *girran,* chattering [?]).

> "He was al coltish, ful of ragerie,
> And full of jergon as a flecked pie."
>
> —*Chaucer*, 1340–1400.

> "Their mystic cabals and jargones."
>
> —*Butler*, 1682.

In these instances the meaning of jargon is somewhat different from that of to-day.

(To be concluded.)

ABBREVIATIONS.

A. D.,	Anno Domini, in the year of our Lord.
a. m. o.,	and many others.
a. o.,	and others.
Ar.,	Arabic.
A. Sax.,	Anglo-Saxon.
B. C.,	Before Christ.
contr.,	contraction of.
D.,	Dutch.
der.,	derived from.
e. g.,	exempli gratia, for instance.
Engl.,	English.
Fr.,	French.
G.,	German.
Gr.,	Greek.
Heb.,	Hebrew.
H. G.,	High German. Since A. D. 1500.
Icel.,	Icelandic.
i. e.,	id est, that is.
It.,	Italian.
L.,	Latin (classical).
M.H.G.,	Middle-High German, A. D. 1150 to 1500 (Weigand).
M. L.,	Middle Latin, from classical period to about A. D. 1300.
N. L.,	New-Latin, since A. D. 1300.
obs.,	obsolete.
O.Engl.,	Old English, prior to about A. D. 1550.
O. Fr.,	Old French.
O. G.,	Old German, A. D. 500 to 1000.
O.H.G.,	Old-High German, A. D. 700 to 1150 (Weigand).
Pers.,	Persian.
q.v.,	quid vide, which see.
Sansk.,	Sanskrit.
Sp.,	Spanish.
Sw.,	Swedish.
=	synonymous with.

SEA-SIDE STUDY ON THE COAST OF CALIFORNIA.

BY J. WALTER FEWKES.

WITH the increased facilities for travel, the number of Eastern naturalists who visit California to collect marine animals with dredge and dip-net, will also increase. Those who are interested in the marine zoölogy of the Pacific Ocean will seek advice of those who have already studied there, as to the best place to carry on their work with profit and with least loss of time. To such the experiences of the author and his convictions as to a good place to prosecute this kind of work on the California coast may not be without interest.

A second and most important object in writing this paper is a plea for the establishment on the Pacific coast of a marine laboratory, where biological research of all kinds shall be carried on.

It is a great pleasure to a marine zoölogist to pull the dredge or drag the Müller's net[1] in waters where these implements have never been used. It is a source of real satisfaction to study a marine fauna in which a majority of the animals captured are new to science, and one may be pardoned if he speaks with enthusiasm of the results of such study.

Such places are many, and opportunities of this kind not so rare that naturalists are obliged to enter upon long journeys to reach them. Even upon the coast of New England where marine zoölogy has been cultivated for many years, the work can hardly be said to have more than begun, while great groups of marine animals have hardly been identified. A preliminary study, however, has been made, and, thanks to the researches of our naturalists whose names, known to all zoölogists, it is not necessary to mention, the facies of our New England marine fauna is known.

When, however, we turn to the western shores of North America, to the coast of California, Oregon and Washington Territory, we find a shore where this study is yet in the first stages of growth, for

[1] The net used in surface fishing. So called because so successfully used by the great naturalist, Johannes Müller.

here the dredge has been but little used, and the revelations of the Müller's net are almost unknown.

The marine animals of the Atlantic have been for a long time the continuous study of marine zoölogists. Those of the bays and seas of Europe and of the Eastern waters of the United States have been so sedulously investigated that it may be said that almost our whole knowledge of animals which live upon the surface of the ocean, is derived from this source. The Pacific Ocean, from its remoteness from centers of zoölogical activity or other causes, is almost wholly unexplored, and while good beginnings have already been made, even the facies of the surface fauna of the Eastern Pacific is practically unknown.

The coast of California, throughout its great length, offers extraordinary advantages for a study of this department of marine zoölogy, and yet, with one or two exceptions, the use of the Müller's net, early introduced on the Atlantic waters of the United States by the elder Agassiz, and so successfully used for so many years by several naturalists, is unknown on a coast washed by the largest ocean on the globe. The use of dredge and net has a great future in the study of the marine fauna of California.

In the first phase of the study of the surface life of the ocean, the work was almost wholly the result of individual enterprise, unaided by government or university appropriations. Naturalists visited, during their vacations, the North Sea, Nice, Villa Franca, Naples, or Messina, accompanied by students, and in that way the foundations of this knowledge were laid. The work which they did has been the admiration of naturalists and their verdict forms a part of the history of science. But in this pioneer work the older naturalists had difficulties to contend with which one who visits the well-appointed stations which have arisen in later years on the Mediterranean, knows nothing of. The places which offer the best localities for collecting were not known, practical fishermen had to be shown the animals which were wanted and how to collect them. In most cases the naturalist himself had to spend many hours on the water collecting, and precious time was used for what might have been done by others. The naturalist was investigator and collector, and his laboratory, oftentimes the room in which he lived, or some place poorly lighted and little fitted for his work. While the combination of collector and investigator in one and the same person [1]

[1] I know of no more absurd position than that of the closet naturalist who despises the collector, or of the anatomist or histologist who belittles

is sometimes an advantage, it is true that much work can oftentimes really be accomplished if these two functions are performed by specialists. In no short time there arose in Europe, in the best localities on the coast, permanent laboratories with all appliances for continuous work. It was no longer necessary for the investigator to explore the coast to find out where the best collecting grounds are, or to make arrangements with fishermen and educate them for the work.

He was no longer obliged to spend months in search of some animal whose favorite habitat and breeding place must be discovered before research upon their anatomy, embryology, or histology, could be carried on, but all these difficulties were reduced to a minimum. Well-endowed stations with equipments have arisen. Continuous observations in the same place have taught when and how certain animals can best be found; and the naturalist now economized time and money, while by working in the established laboratories he finds himself associated with others interested in the same work. Much praise must be given to the pioneers in this study, and the younger school of naturalists, from the vantage ground which they occupy, are apt to overlook the difficulties which those before them encountered.

On the Atlantic coast of the United States we have passed or are passing into a second stage in the development of the study of marine zoölogy. While the older American zoölogists in their earlier days sought the shore with no help from state or college, we now have well-equipped laboratories bringing many other advantages. The contributions to science made by the U. S. Fish Commission, Mr. Agassiz' Newport Marine Laboratory, and the Chesapeake Marine Laboratory, tell of the harvest which may come from the second stage in the development of marine research in America. While these stations have accomplished a great deal in carrying on the study, much is done every year by summer schools of natural history and by individual naturalists unconnected with any of these stations or schools. Professors of our colleges visit the shore with pupils, and in several instances have made extended investigations wholly independent of public or private marine laboratories. These efforts have much to recommend them, but are

the systematic zoölogist. It is, as suggested to me by a well-educated naturalist for whom I have great respect, like the hands of the clock saying to the pendulum, "I have no need of thee."

often hampered for resources, as they involve in many instances large outlays for boats, dredges, and fishermen. Moreover, some of the best localities for the study of marine zoölogy are visited by these private parties.

On the Pacific coast the study of marine zoölogy has entered upon the first phase of the development, but has not passed to the second. No marine station has yet been founded there. The naturalist who seeks those shores must himself discover the best place to work. He finds no fisherman familiar with his needs, and must educate them in the use of the dredge. In short, feels that he is veritably a pioneer, if he has in mind the use of the net and dredge. The delights and results of his work, however, are those which come to the first worker in a new field.

When I had decided to visit the California coast to study its marine fauna, the first information which I sought was where is the best place to get the best results in the shortest time? The first question which was asked local naturalists was, where is the best place for the study of marine zoölogy on the coast? I received in most cases no satisfactory answers, and perhaps I ought not to have expected them. Prominent marine zoölogists in Europe differ in their estimates of the value of localities on the Mediterranean as collecting places. Many say Villa Franca, others Naples, others Messina. On the coast of New England some of our prominent naturalists prefer Newport, others Wood's Holl, others Eastport. Every one has a preference, but it is a known fact that there are some places on our coast which no one recommends. The coast of California, however, has been so little studied that even the satisfaction of knowing the prominent places was not allowed, as I could find almost no one who had used the dredge. The first thing necessary there was a kind of geographical exploration to discover a good place for work.

It may be of advantage to others who have in mind a visit to the Pacific coast for work similar to that which I carried on to know the result of my experiences. I have used the dredge and Müller's net at Santa Barbara, and among the neighboring islands, at Port Harford, Santa Cruz and Monterey. I can recommend any of these places for this kind of work; but I prefer the Bay of Monterey, and think if ever a marine station is founded on the coast of California, no better site can be chosen north of Point Conception than on this beautiful bay. I am sanguine enough to hope that in

time two marine stations will arise on this coast, in which case the Bay of Monterey and either San Diego[1] or Santa Barbara might well be chosen.

There are several desiderata which influences the marine zoölogist in his choice of a working place upon any shore. The first, perhaps the most important one, is whether the collecting is good, whether there are many animals at the place recommended. This is an all important, but it is by no means the only question. Of what use is it to a naturalist if he can stand on a wharf and see a wealth of surface life float by and can get no boat to collect it? This might seem an absurd condition on the coast of New England where every coast hamlet has so many boats; but I have been in a considerable village on the coast of California where one or two large, undesirable boats were the only boat facilities of the place. In Santa Barbara, which has the reputation of being a boating place, you can count on your two hands the number of small boats for rent. Several conditions have brought about this result. In most places the wharf is built out from a beach on which the surf is continually breaking. There is no protection for boats, and the fondness of the New England coast people for the water is not known. Although so many strangers come to Santa Barbara, there are few pleasure boats and no skippers. Compare this condition with the wharfs, for instance, at Newport or Eastport.

It is not alone necessary for the marine zoölogist that he should have a good collecting ground and a boat, but he must be able to reach the coast easily. If he studies animals alive his laboratory must be on the shore, for pure water must be continually supplied, and the live animals of the fragile nature of many marine creatures cannot be carried for long distances without harm. It is best if his laboratory is as near as possible to the water. The New England fishing towns, many of which arose as fishing hamlets, lie upon the very shore, and accommodations are easily found to satisfy the naturalist's wants. That is not always the case, however, in towns which have originated like those of California. The holy fathers who were the founders of Santa Barbara and Santa Cruz did not look to the sea for a livelihood. The first settlers were not fisher-

[1] Unfortunately, circumstances prevented my spending any time at San Diego in the study of surface animals or in dredging. I confess my ignorance of its advantages, which from what I could learn from others and my own superficial examination of the neighboring coast, must be very great.

men, nor was commerce at first of great importance. As a result many of the coast towns are separated by some distance from the wharf or landing-place. One knows how much discomfort this may mean to a naturalist if he has trudged along over a mile from the wharf to the nearest house he could rent for a laboratory, with a water-bucket filled with the products of surface fishing by night, and if twice a day he has been obliged to replenish the water by a similar tramp. Time is lost which might be employed for work, and the naturalist cannot watch and take advantage of the ever changing conditions of the sea and wind if his workshop is a mile or more from his boat. The naturalist who studies ichthyology,[1] and who visits the fish markets when the fishermen return from their nets, does not feel these discomforts which the naturalist who must collect for himself has.

A good collecting-place, boats, and ready access to the water are three requisites in a choice of a good station for marine work. They are the great difficulties which the pioneers in marine zoölogy have always encountered. The naturalist who works in a well-equipped station, with trained fishermen for collectors, knows little of these difficulties. Until, however, a zoölogical station is founded on the coast of California these three things, unfortunately or fortunately, must have great influence in his choice of a working-place.

The Eastern zoölogist, who has worked on the Atlantic, encounters several physical characteristics on the coast which are new to him. The absence of those nooks and indentations of the coast, pockets in which floating life is driven by the currents and winds, is a marked feature of the coast line. Many of the harbors are open roadsteads upon which a surf is continually breaking. While this feature is in some respects a disadvantage, it is in others an advantage.

Along the coast in many places, as at Santa Barbara, a zone of floating kelp undoubtedly prevents many floating animals from being washed to the shore. This kelp extends for miles along the coast, and it is only where the bottom sinks immediately to a great

[1] In this article I have considered more especially the needs of the student of the marine invertebrated animals, as the largest share of oceanic life belongs to these groups. In many instances it will be found that the needs of the ichthyologist are very different. They have little to do with dredging, but the student of the embryology of marine fishes and their younger stages will appreciate what is desired in work with the Müller's net.

depth near the shore that it is absent. While it may shut out effectually many floating things from the neighborhood of the wharf, it shelters in its fronds many others; while the root-like attachments to the rocks harbor many interesting animals. Between the zone of kelp and the shore was not found to be a profitable dredging-ground. The interval appears to be filled with decaying fragments of the kelp, and the dredge comes up filled with this debris. Dredging in the belt of the kelp itself is impossible.

The best dredging at Santa Barbara is in the channel about four miles outside the outer border of the kelp. The rocks in places entangle and catch the dredge, and the bottom is, except in one or two places, very rocky. Off Punta del Castillo, near Santa Barbara, there is some good ground for dredging, but it is hard to pull the dredge on account of the many submarine rocks. From Santa Barbara across the channel to the Santa Barbara Island, there are many rocks, but the dredging is good in places. The vicinity of Carpenteria is the best place of all about Santa Barbara for dredging.

The island of Santa Cruz,[1] one of the most beautiful islands of the Santa Barbara group, offers fine surface collecting. The dredging is difficult on account of the many submarine rocks and the depth of the water. To one visiting the island for zoölogical study no better anchorage can be found than a small cañon resorted to by otter hunters near Punta Diablo. The shore collecting on the beach at Santa Barbara is poor. At Punta del Castillo many interesting animals were found.

Santa Barbara on the whole offers good facilities for the study of marine zoölogy. The fauna of the shore is not rich, but it is varied, and that of the neighboring islands is all that could be desired. The surface fauna of the Santa Barbara channel is very rich and dredging in it is excellent. I do not believe the shore at Santa Barbara can compare with that to the south by Del Mar and San Diego as a collecting place for the naturalist, but the dredging is good and the surface collecting all that could be wished.

[1] Especial interest is attached to a study of this island from the curious distribution and character of the flora as compared with that of the main land. This island, continental to all outward appearances, has a more peculiar flora than the Bermudas, although they are only a little over twenty miles from the shore, while the Bermudas are five hundred. No more interesting problems can be studied in regard to the geographical distribution of animals than the character of the life of the islands near Santa Barbara.

In order to study the conformation of the coast of California between Santa Barbara and the Bay of Monterey, and to form a judgment of the advantages of the several ports for natural history work, I took one of the smaller steamers of the Pacific Navigation Company, which touches at the several landings. I did not dredge in all these places and my judgments may be more or less hastily made. They are thought to be of some worth.

Gaviota seems illy adapted for surface work, as I am told that a stiff breeze from the mountain pass almost continually ruffles the a. As we approached the wharf at about nightfall a cold boisterwind from the mountains seemed to prevent any night work with the net.

Harford seemed made on purpose for the study of marine The wharf is well situated for landing with treasures, the hotel is contiguous to the shore. Small islands and rocks of cess afford good collecting ground for litoral animals. ng animals were observed in the neighborhood of the

meon and Cayucos are open roadsteads with few fishermen, little calculated for the purposes of the naturalist.

little hamlet of El Moro lies favorably for work, but at t the steamers do not land there. These three places would teresting places to carry on marine research, as few animals been recorded from their neighborhood, and they are rarely ited by naturalists.

The coastline from Cayucos to Monterey is one series of lofty cliffs which have been little explored. No villages large enough to necessitate the landing of the steamers exist, and although there is probably a multitudious marine life in the water, no point seems adapted at present for the study without great inconveniences. It would be impossible to get boats and fishermen on this unknown coast. San Simeon is a dairy town and few fishermen are found there, although there is an easy communication with San Francisco and other prominent ports on the Pacific, by means of the Pacific Steamship Company.

Santa Cruz presents many conditions which render it a good place for the marine zoölogist to work. There are many fishermen and boats can be had at reasonable rates. It has good hotels and boarding-houses contiguous to the landing-places. There is a good sandy beach and near by rocky cliffs both with characteristic life. The

dredging is good. The neighboring town, Soquel, when there are many fishermen, presents many facilities for the naturalist.

Collecting on the piles of the wharf is not as good as at Santa Barbara. There is no belt of kelp forming a thick zone shutting out the floating genera from the shore. The phosphorescence is at times superb, but surface collecting in the afternoon was found to be next to impossible. The beach is more sheltered than that of Santa Barbara, but it rarely happens that the surf does not break on the shore. Sheltered caves or natural pockets in which floating life are caught are rare.

Taken all in all, Monterey [1] is one of the best places on the coast of California for a naturalist to station himself for a study of the marine life of the Pacific. It may not be the best, but experience has taught me that it is *one* of the best, and a visit there by a naturalist will be amply repaid by novelties if his object be research.

The surface fauna is rich and there is good dredging. There are boats of all sizes and many fishermen. The city lies near the shore and one is not forced to waste time in reaching the wharf from the hotel. The means of communication with the outside world are easy. I find, on reference to my note book, that many of my choicest specimens came from this locality.

Stimpson found the bay of San Francisco nearly barren of a varied marine life except at its entrance. This condition he ascribed to the admixture with its water of the turbid flood of two large rivers and the small size of the gate which admits the clear waters of the ocean. A short and somewhat superficial examination of the resources of the bay lead me to a somewhat similar conclusion, yet I find the entrance to the bay one of the best places for floating animal life. From the wharf several very interesting floating animals were taken, and there is evidence that the marine zoölogist will find plenty to occupy his attention within a short distance from the city. A great advantage of San Francisco as the site for zoölogical work is the vicinity to scientific libraries and the number of fishermen and fishing boats which the city has.

Climatic conditions on the coast of California render certain times of the year most advantageous for work with dredge and net. In most parts the morning is the best time for surface collecting. A

[1] Camelo Bay is believed to be one of the most advantageous places for the study of marine zoölogy between Point Conception and San Francisco.

stiff breeze ordinarily arises in the afternoon and renders the collection of surface life almost impossible. Surface collecting by night, so profitably carried on at Newport, met with considerable success on the coast of California. The fogs which in some months hang for many hours above the water is detrimental to this kind of work.

Calms, while of great advantage to the student of surface collections, try the patience of the naturalist engaged in dredging who has no steam launch at his control. The best time to dredge [1] with a sailing craft was found to be about noontime, as there is less liability to be becalmed at that time, and it is too early for the heavy winds of the afternoon.

In my trip across the Santa Barbara Channel, the Müller's net was used at intervals to get some idea of the general facies of the surface life from this region of the Pacific. The contents of the net was made up of representatives of all the more important surface animals from the Narragansett Bay. These animals are of course represented by different genera and species from those found in New England waters, but the general character of the surface life is much the same. As compared with the same latitudes on the Atlantic, it did not seem as rich.[2]

The phosphorescence which is a direct index of the amount of surface life in the sea is often very brilliant on the Pacific coast. I have studied this light at various points on the Mediterranean, along the Florida Keys, on the coast of New England and at the Bermudas but have never seen it more striking than in the surface waters of the Santa Barbara Channel and in the fiords of the island of Santa Cruz. In a canon fiord under Punta del Diablo, at about 9 o'clock in the evening, I witnessed a phosphorescent display of this kind of most extraordinary character. Aside from its natural beauty it was indicative of an abundant harvest with the Müller's net. The signs did not fail, although the light, as so often happens in surface collecting, was mainly due to multitudes of one genus of animals. At this time it was due to large numbers of a species of Copepod which is often very abundant in the Santa Barbara Channel.

I have noticed in studies of live animals carried on at the Bermudas, at Tortugas and on the coast of New England, that in the

[1] I refer to shallow-water dredging and to dredging with the sailing crafts which a visitor to the coast is obliged to use.

[2] The author has in preparation a paper in which the new genera and species of invertebrated animals found on the coast of California in surface collecting and shallow-water dredging will be described and figured.

former localities marine animals in aquaria are very tenacious of life. I believe this is in part due to the fact that there is a more uniform temperature in the winter at Tortugas, or that the changes are not as sudden in one place as in the other. At Newport, for instance, the temperature of the water varies very greatly day by day, and pelgic animals are very sensitive to this change. Pelagic animals at Santa Barbara live longer without change of water than those on the coast of New England, and the conditions of temperature seem more like those of Bermuda than of the coast of New England.

I was much surprised at the great range of temperature which the common Actinian of California can bear without harm. Water which is almost lukewarm does not kill it. In pools left by the tide well-expanded specimens live for hours in water exposed to the rays of the sun. By the peculiar habit which they have of covering themselves with sand they are able to live out of the water in the warm air for several hours.

I can think of few more difficult tasks than to determine the best locality in New England to place a zoölogical station. Any committee which has such a task, especially if a majority of its members are those who have never done any marine zoölogical work at any place, has my hearty sympathy. There may be places better adapted for this or that kind of work, better suited for the sise of the endowment or more convenient of access, but it is a hard task to declare which is the best place for a station. One is tempted to say that there is no place which is bad if the naturalist means to *do* work rather than discourse on *how* to do it.

On the Pacific coast the problem is the same as on the Atlantic. One cannot say that this or that point is the best place to work until he or others have tried all. Honest work at almost any place on the Pacific as on the Atlantic marine zoölogy will bear good fruit.

The time has come when a permanent, well-endowed zoölogical station is needed for the study of marine animals of the coast of California. An abundant harvest in all branches of zoölogical study awaits those whose good fortune it may be to originate and carry on such a station.

While it is not intended in this article to belittle the contribution to our knowledge of the animals of the coast which have already been made, it is believed that the work already begun is but a small part of what will result if a permanent station, directed by those

who have been drilled in methods of study in marine laboratories in Europe and America, is established.[1]

The author has been told that a movement is now on foot to found a marine zoölogical station in California. It is hoped that the information is correct. It is believed that if such a laboratory is properly conducted it will lead to most important results in the advancement of science.

EDITORS' TABLE.

EDITORS: E. D. COPE AND J. S. KINGSLEY.

THE satire which has been everywhere for a half century leveled at the classical names of towns in New York State, given by some schoolmaster who was in a position to give them, should have taught American nomenclators of later date a lesson. Perhaps the reference to the classical dictionary has been less frequent since that time, but the poverty of imagination of the modern American has been none the less apparent. It is pardonable in immigrants to name a locality in America after their birthplace in some European country; but when the "stock American" must search European and classical geographies for names, he advertises two things: first, his want of esthetic capacity; second, if perchance he select some euphonious name from the Greek, his want of national spirit and character—in form at least. What can be more incongruous than the naming of one of the canyons of Colorado the Canyon of Lodore! But what especially moves us to make these remarks is the fact that we are threatened, according to the daily press, with a still more objectionable piece of Jenkinsism. The plain adjacent to the Salt River of Arizona, where so many important archæological

[1] It would be a most interesting part of my article, if space permitted, to record the many valuable papers which have already been published on Californian Marine Invertebrated Animals. These are mostly in systematic zoölogy. The Molluca are well known, something is known of the Crustacea, Echinoderms, Actinians, and Medusæ. The sponges, Bryozoa, Tumicata, Worms, Nudibranchs and one or two other groups await even systematic identification and description. The study of larval forms of animals, of embryology, of anatomy and histology is almost unknown as far as California marine invertebrates are concerned.

remains have been recently discovered by the Hemenway Expedition, is to be called The Plain of Tempe! Can no names be selected from the noble vocabulary of the Pueblos, or from the Spanish-American historian of three centuries ago, that we must once more throw away our character in this way. Let us see. The name of the Great Colorado River, into which the Salt River ultimately finds its way, was the Tison—a dignified name, capable of almost any application. The region of the Moquis was Tesayan. The region of the Puerco River of the East was Tiguex—a word of entirely classical form. The Rio Grande was the Cicuyé. Towns of the region were Acuco, Tutahuaco, Chia (modern Cia), (north of which was the Province of Quirix), and Braba, at the head of the Jemez River. All of these are available names, of euphonious and even classical form, appropriate to the country, and not copied from any other region. We commend them respectfully to the gentlemen in charge of the Hemenway Expedition.

Cannot something be done to change the north, south, east and west places that we have in such numbers, and to prevent the creation of any new ones? Why shall we disfigure our map with a North Dakota, for instance? Call it Mandania, or some other original name. The Canadians have preëmpted Assiniboia—so we cannot use that. Let us have Tacoma for Washington Territory, as has been long proposed. When Montana is divided, name one of its parts Absaroka, after the Crow Indians—the best specimens of the aboriginal American on the continent.

We recall two instances of changes of name in the East, with which we emphasize our remarks. New Jersey once had a flourishing town of Longacoming. The name was one of the few instances of successful composition of English words to be found in America. It was changed by some person of perverted sensibilities to Berlin, and is now so called! In eastern North Carolina is a pretty village once called by the euphonious Indian name of Nahunta. When we last visited the place it was called Frémont, spelled with an "é." Comment is unnecessary.

RECENT LITERATURE.

Gray's "Elements of Botany."[1]—This is a thorough revision of the deservedly well-known *Lessons* in which, for almost a generation, American botanists have made their first acquaintance with elementary botany. In the revision the venerable author reverted to the title of his first book, which appeared fifty-one years ago! Naturally, this coincidence of names suggests a comparison of the two books.

The first *Elements* was a duodecimo of four hundred and twenty-six pages, and was brought out by the house of G. & C. Carvill & Co., of New York, in 1836, the preface bearing date of April of that year. There is a good deal of similarity between this pioneer and the book which now, after the lapse of half a century, bears its name; and still there are very many differences.

In the early book the word protoplasm did not occur, for the very good reason that Mohl had not yet coined it; nor is there any direct reference to the thing, while in the present work protoplasm, cells, cell-contents and cell-walls, receive sufficient attention to give the beginner a general knowledge of what they are.

Vegetable physiology was very crudely treated in the earlier book, the extensibility, elasticity, hygroscopicity, endosmosis and excitability of plant tissues being gravely discussed in a way in striking contrast with the admirable summary given in Section XVI. of the later work.

In the first *Elements* "spongioles" were still supposed to be the organs of absorption in roots, and there was supposed to be a distinct ascending and descending sap in the stem. The turpentine of the Conifers and the latex of various plants were considered to be special kinds of descending sap. The movements of plants were discussed as among the curious things, but the meaning or purpose of the movements was not suspected. In describing *Dionæa muscipula*, it was said of the unfortunate insect that its "only chance of escape consists of remaining perfectly quiet until the leaf uncloses"! Pollination was, of course, treated in the old way: the Barbary stamens were said to "seldom fail to project a quantity of pollen upon the stigma," and it was stated that "the relative position of the anthers and stigmas is generally such as to favor mechanically the application of the pollen to the latter."

Turning to the new book, one sees what a great advance has been made in this field—which we may call Darwinian botany—in which such terms as close fertilization, cross-fertilization, cleis-

[1] *The Elements of Botany, for Beginners and for Scholars.* By Asa Gray. Ivison, Blakeman & Co., New York and Chicago. 1887. 8vo., 226 pp.

togamy, anemophilous and entomophilous flowers, dichogamy, heterogamy, etc., etc., occur. Not less striking is the contrast between the new and the old in the chapters which treat of the flowerless plants. Half a century ago the spores of the Equisetaceæ were still doubtfully discussed: the sporangia of ferns were supposed to be transformed leaves, and the search for their stamens and pistils had scarcely been given up. In these and the mosses—in fact, throughout the whole of the Cryptogams—there was no hint, as yet, of sexual organs. Compare these crude paragraphs with the concise and lucid exposition given in the new *Elements*, where the same groups of Cryptogams are discussed—but how differently! Pteridophytes and Bryophytes are given modern characters and a modern treatment. Thallphytes are briefly treated under Algæ, Lichens and Fungi, although with the statement that "of late it has been made most probable that a lichen consists of an alga and a fungus conjoined;" and, further, that "botanists are in the way of bringing out new classifications of the Thallophytes, as they come to understand their structure and relations better."

When the earlier book was written Linnæus had been dead but sixty years, and his system had still so strong a hold that eighteen pages were given to an exposition of it and a discussion of the question of supplanting it with something better; and the Natural System stood so much in need of argument that forty-four pages were given to it. In the new book a short paragraph is all that remains of the discussion of the Linnæan System, and less than two pages suffice for the Natural System.

It need only be said that not only do these contrasts show us what advances have been made in botany in half a century, but a comparison of these two books shows, still more, the remarkable growth and perennial youth of the master-mind who wrote them. It is not given to many men to live to see such great changes in the aspect of a science as has been the good fortune of Dr. Gray, and still fewer have had the strength or ability to adapt themselves to the new views and theories.

The new book has so much to commend in it that we are loath to lay it down. We particularly like these sentences in the preface: "No effort should be made to commit technical terms to memory. Any term used in describing a plant or explaining its structure can be looked up when it is wanted, and that should suffice." And this one, on page 156: "Even the beginner in botany should have some idea of what Cryptogamous plants are, and what are the obvious distinctions of the principal families." We like the adoption of the spelling, Phanerogam, and the names Pteridophyta and Bryophyta, and the abandonment of the "superfluous" terms *frond* and *stipe* and replacing them with *leaf* and *petiole*, in describing the structure of ferns.—*Charles E. Bessey.*

KARPINSKI'S "UBERSICHT DER PHYSIKE-GEOGRAPHISCHEN VERHÄLTNISSE DES EUROPÄISCHEN RUSSLANDS.[1]—This brochure, with its series of small maps, is a valuable addition to our knowledge of Russian geology. At the outset the author states the curious fact, that even the oldest sedimentary rocks of Russia have not been altered, clay and sand being recognizable even in Cambrian strata, and a layer beneath the sediments of the coal formation being in some places recognizable physically and chemically as turf. Crystalline gneiss comes to the surface in Finland, Olonetz and Archangel, also in Volhynia, Podolia, Cherson, etc., in the south of Russia. Crystalline rocks are met with at a depth of 100 Russian fathoms below St. Petersburg, and at 300 to 500 fathoms below Moscow.

The oldest sedimentary strata (Cambrian) are the plastic clays of the St. Petersburg and Esthonian governments. Upper Silurian sediments occur in localities distant from each other, in the governments just named, in the south of Poland, and in three points on the eastern limits of European Russia. There can be little doubt that the Cambro-Silurian sea extended across the centre of Russia, from the Baltic to the Ural. In Upper Silurian times this sea had become much smaller, and was for the most part limited to the west near the Baltic, with an outline in Podolia and northern Bessarabia. Upper Silurian beds also reappear in the north. Thus at the commencement of the Devonian probably almost all European Russia was dry land, though sea spread from the Urals far over Asia. The fauna of this eastern Lower Silurian sea strikingly resembles that of the basin of the same age in Western Europe, though separated from it by 200,000 square versts of Middle and Upper Devonian strata. This later Devonian sea extended from the Arctic Ocean to the Caspian region. Only about 150 species of invertebrates are as yet known from the Devonian of Russia, whilst almost three times this number occur in Belgium. During the Carboniferous period the greater part of Russia was covered by the ocean, though the coast had advanced eastward since the Upper Devonian. This Carboniferous sea spread westwards over Asia to the Irtish and Altai.

In Permian times parts of Cawland and Poland were covered by the sea; but, though the eastern coast of European Russia was pushed forward considerably, an unbroken sea still covered eastern Russia from the Arctic to the Caspian. The Siberian sea probably became dry land before the beginning of the Permian. The main Permian sea probably communicated with that in the region of the Aracco by a strait on the site of the Caspian. In Triassic times this sea still farther dwindled, until finally it became a network of

[1] Ubersicht der Physike-geographischen Verhältnisse Europäischen Russland wahrend der verflossen an geologischen Perioden. Von A. Karpinski, a. d. "Beitragen s. Kennt. d. Russ. Reiches. u. d. angrenzenden Lander Asicris." St. Petersburg. 1887.

separate basins. This change, commenced in the Permian, ended by converting into dry land all European Russia except the southwest part of Poland. During the Middle Trias, Upper Trias, and Lower Jurassic, the land surface of Russia was much as now, except that marine beds occur in southern Poland, and Liassic beds in the Crimea and Caucasus. In Upper Jurassic times the sea again spread over a large part of Russia, probably commencing in the west, as is evidenced by typical Middle Jurassic strata in that quarter. The similarity of the fossil forms of this wide-spread sea, which stretched from the Arctic to the Caspian, and covered most of the Caucasus, to those of Western Europe indicates free communication. At the end of the Jurassic period the area of this sea became much narrowed by the advance eastward of its eastern coast line, yet still communicated with the Jurassic waters of Western Europe until the Upper Volga stage. During the Lower Cretaceous only a narrow belt of sea divided the land of Europe from that of Asia towards the north, and this belt disappeared in the Upper Cretaceans, at which period, however, the loss was more than compensated for by the submersion of almost the whole of Southern Russia. During the older Tertiary the northern boundary of this sea advanced southwards. In Miocene times the regions around the Caspian and Black Seas formed part of the Mediterranean and Sarmatian basins, the latter extending eastward to or beyond the present Aral Sea. Lastly, in Post-Pliocene times, the Aralo-Caspian basin covered a large area northward of the Caspian, while the ice of the Glacial Period swept downward from the north over by far the greater part cf European Russia, almost reaching the Aralo-Caspian basin. W. N. L.

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GENERAL NOTES.

GEOLOGY AND PALÆONTOLOGY.

On the Theory of Glacial Motion.[1]—As glaciers deport themselves like rivers, in that they are constantly flowing, with greater velocity at centre than at margins, above than below, form pools and rapids, and conform themselves to channels, Prof. Forbes was led to propose the theory that: "A glacier is an imperfect fluid or viscous body which is urged down slopes of a certain inclination by mutual pressure of its parts."[2] He explained the veined structure of glaciers as being due to differential movement of its parts.

Against this view, it was urged that ice is a brittle solid, which in the laboratory cannot be moulded as a semi-fluid, or even in nature, when in passing over a change of declivity of even 4½ degrees, it becomes ruptured. Consequently, Prof. Tyndall applied Faraday's "Law of Regelation,"[3] that ice when broken and moistened, re-united and could be moulded into any form by repeated crushing and pressure, and proposed the "Fracture and Regelation theory." He explained the veined structure of glaciers as being analogous to the slaty cleavage of certain rocks—the result of transverse pressure.

Canon Moseley[4] calculated that the resistance of ice to descent is thirty-four times gravitation, and, therefore, fracture and gravitation could not be maintained. He likened the motion to the creeping of a leaden roof, owing to the expansion and contraction from change of temperature, which expansion Dr. Croll[5] modified in assuming the transmission of heat from molecule to molecule with successive liquefaction and solidification of the glacial waters.

Malleability, plasticity and viscosity are different degrees of the same property. Prof. Heim[6] distinguishes between these last two semi-fluid forms. In plastic bodies, the internal cohesion is less than internal resistance, and, therefore, under pressure these will flow, but under tension they are not drawn out, but are brittle. In viscous bodies, the internal cohesion is greater than internal resistance, and, therefore, they will not only flow under pressure, but in tension they are drawn out before rupture. He concludes that glaciers are plastic bodies, and explains the veined structure as being due to partial liquefaction under compression in passing through narrow

[1] Read before the Royal Society of Canada May, 1887, and before the A. A. A. S., Aug., 1887. Printed from advance sheets of Trans. Roy. Soc., Canada, for 1887.

[2] Travels in the Alps, 1843.

[3] Forms of Water.

[4] Proc. Royal Society, 1869.

[5] Climate and Time.

[6] Handbuch der Gletscherkunde von Dr. Albert Heim, Stuttgart, 1885.

channels, as it had been discovered that ice can be melted by pressure (Thomson). He attributes the motion to plastic flow under gravity, rupture, partial regelation, and a sliding motion (which is slight).

From observations in the Alps, and especially in Norway, my conclusions are that the motion, in the main, is the result of gravity on a semi-fluid body, wherein there is viscosity as well as plasticity, as defined by Prof. Heim; the motion, of course, being greatly modified by heat. My conclusions are based upon:—(1) The flow of the glacier, not merely in conformity to the channel, but about loose stones, which cause the lower surfaces of the glacier to be grooved (see fig. 1, in my Glacier Erosion in Norway[1]) without any lateral ridges being produced from the ice that filled what are now its channels, such being moulded into the mass (this is *plasticity*). (2) A tongue of ice (see fig. 3) pushing against a boulder, was bent back without rupture on either side of the hanging plate,—the ice on one side being in tension and on the other in compression (here is viscosity). (3) A large rounded boulder (see fig. 2), held in the side of a moving glacier, where the rounded ice wall rose about thirty feet above the stone, which was being rolled along as the ice moulded around it, had just been crushed by weight. The glacier rose along its winding course to the snow fields, 1,500 to 2,000 feet above the stone. Consequently the crushing weight upon the granitoid boulder must have been derived from the vertical component of the momentum of descent of the whole mass, which could be transmitted thus only through a semi-fluid body. (4) The flow of the upper layers of ice over the lower was seen when the glacier was impeded by a barrier (see fig. 4).

The experiments of Herr Plaff[2] show that a solid body can be pressed into ice at a temperature about freezing point as rapidly as glaciers ordinarily move; whilst at a temperature a little above, the motion is greatly accelerated, but if below 0° c, the plasticity of the ice diminishes rapidly to almost zero. However, as shown by the sub-glacial streams in winter, the temperature of the inferior surface glacier is not below freezing point.

The effects of increased summer sunlight, as well as direct heat, as shown by the experiments of Rev. A. Irving,[3] in which he transmitted both sunlight and heat waves through ice, is to accelerate the movement as the former is converted into heat undulations, and radiated against the lower part of the glacier from the adjacent rocks, thus increasing the fluidity of the ice and flow of the glacier, owing to increase of temperature.

The temperature of the lower surface of the glacier is also slightly increased by the radiation of the internal heat of the earth, yet

[1] See American Naturalist, March, 1888.
[2] Nature, Aug. 19th, 1875.
[3] Q. J. G. S., Feb., 1883.

this is very slight, as the amount radiated per annum is only enough to melt 6.5 millimetres of ice.[1]

Although glaciers do not conform to all the inequalities of their beds, and at the ice-falls and elsewhere became fractured, and subsequently re-united, whether by heat regulation or plastic flow, the fluidity theory is the most acceptable explanation of the motion of glaciers, even when the angle of descent is reduced to almost zero, and modern observations only supplement the reasons upon which Prof. Forbes proposed his theory more than forty years ago.—*Prof. J. W. Spencer.*

A Cretaceous Bird-Track.—Professor F. H. Snow has recently, in the *Trans. Kansas Acad. Sciences,* described a fossil bird-track discovered in the Dakota sandstone, in Ellsworth county, Kansas. The impression appears to have been made by the left foot of some bird with an elevated hind-toe just reaching the ground. The ball of the foot is deeply impressed and the posterior toe has made an unmistakable imprint, proving the avian character of the footprint. It measures two inches from anterior middle claw to claw of posterior toe. This discovery considerably lowers the geological horizon of Kansas birds, since nearly all the material for Marsh's *Toothed Birds* was obtained from the Niobrara, the highest group of the Cretaceous represented in Kansas. Below this lies the Benton, followed by the Dakota, resting unconformably on the Permo-Carboniferous rocks.

Professor Snow continues thus: "The wonderful luxuriance of the land vegetation of the Dakota, and its marvellous similarity to the Dicotyledonous forest-growths of the warm-temperate climes of the present day, have rendered these sandstone beds a most fascinating field of investigation for both Paleo-botanists and Neo-botanists. The finely-developed and perfectly-preserved foliage of oaks, willows, poplars, laurels, sarsaparillas, magnolias, sassafras and other kindred forms belonging to genera now long since extinct have hitherto suggested a beauty of landscape whose perfection was only marred by the apparent scarcity of animal forms. . . . . Our bird-track supplies the missing element of graceful ærial forms. From the size of the footprint, it may be safely inferred that the bird which left it was somewhat larger than a pigeon. It was probably a bird with teeth," "with habits similar to those of the modern tern."

The Affinities of Miolania.—G. A. Boulenger reports (P Z. Soc. Lond., June 23, 1887) that the large Plistocene Chelonian Miolania, which was regarded by Huxley as probably belonging to the group Cryptodira, and closely allied to Chelydra, Macroclemmys and Platysternum, is, in fact, like all the recent tortoises of

[1] Elie de Beaumont, Thompson Woodward and others, give range from five to eight millimetres. University of Missouri, May 1st, 1887.

Australia, a member of the Pleurodira. Mr. Boulenger bases his opinion upon the examination of a nearly perfect skull with the two cervical vertebræ attached. The structure of the alveolar surface of the skull indicates an herbivorous animal; the ungual phalanges and the curious sheathed tail a terrestrial one. This sheathed tail, with its opisthocœlous centra, is unique among the Pleurodira, and points to a distinct family. The ilium shows a surface for attachment to a sacral.

The Pleurodiran characters are—the broad pterygoids, with outer palatal borders forming wing-like expansions; the tympanic cavity completely surrounded by the bony roof; the articulation of the mandible by a condyle fitting into an articular concavity of the quadrate, and the form of the cervical vertebræ.

Geology of the Solomon Islands.—Mr. H. B. Guppy has recently published a work upon the Solomon Islands, divided equally between the volcanic and calcareous members of the group. The volcanic islands fall into two classes—the first comparatively modern and mainly composed of little-altered augite sandstones, andesitic pitchstones, tuffe and agglomerates; the second, composed partly of the above rocks, but in part of much more ancient crystalline masses, consisting chiefly of altered dolerites, quartz-diorites and porphyies and serpentines.

The coral rocks of the Solomon Islands are divided by Mr. Guppy into: (1) True coral limestones; (2) Coral limestones which have the composition of the coral muds or sands now forming near coral reefs; (3) Rocks having the composition of volcanic mud and pteropod ooze; (4) Foraminiferal limestones; (5) Rock resembling a consolidated deep-sea clay (red clay). The two last classes were evidently deposited at depths of not much less than two thousand fathoms in an ocean far from continental land; and this is the first proof of their existence above sea-level.

Mr. Guppy draws the following inferences: (1) That these upraised reef-masses, whether atoll, barrier reef or fringing reef, were formed in a region of elevation; (2) That such upraised reefs are of moderate thickness, their vertical measurement not exceeding the usual limit of the reef-coral zone; (3) That these upraised reef-masses, in the majority of islands, rest on a partially consolidated deposit which possesses the characters of the "volcanic muds" that were found, during the Challenger Expedition, to be at present forming around volcanic islands; (4) That this deposit envelopes anciently-submerged volcanic peats. The author says: "I never found one (raised reef) that exhibited a greater thickness of coral limestone than one hundred and fifty feet, or, at the outside, two hundred feet."

Geological Survey of Arkansas.—From a small pamphlet —Annual Report of the State Geologist of Arkansas for 1887—

we learn the Survey began work June 24th, with a corps of a director, three paid and seven volunteer assistants. The work done the first year has been the triangulation of the immediate vicinity of Little Rock; the examination of localities reported to yield gold and silver, especially in Garland and Montgomery counties; a reconnoissance in the central part of the State; tracing the limits of the Cretaceous in the southwestern part of the State. The bill providing for the survey makes appropriations for its continuance for two years.

GEOLOGICAL NEWS.—PALÆOZOIC.—Dr. J. V. Deichmüller describes two new species of the genus Etoblattina Scudder obtained at Grügelborg, near St. Wendel (Rhenish Prussia), not far from a spot where fish, insect and plant remains have been previously found. They are described under the titles of *E. ornatissima* and *E. rollei.*

CRETACEOUS.—Mr. A. S. Woodward concludes, after examination of the five series of examples in the British Museum, that *Cyclobatis oligodactylus*, the so-called "Torpedo," from the Cretaceous of Mount Lebanon (Syria), is really a member of the sting-ray family (Trygonidæ). Among his reasons are: The pectoral fins are uninterruptedly continued to the end of the snout, and were thus, probably, confluent in front—a condition never met with among the Torpedinidæ; the pelvic arch is placed far forward; there are no traces of median fins, and the skin is armed with spinous tubercles.

FROM an examination of specimens in the Cambridge and Brighton Museums (Eng.), Mr. A. S. Woodward concludes that the puzzling genus Ptychodus, which was by Agassiz and Owen referred to the Cestraciontidæ, is doubtless a true ray, though possibly belonging to an extinct family.

MR. J. W. DAVIS (*Trans. Roy. Dublin Soc.*, 1887) describes the fossil fishes of the chalk of Mount Lebanon. In this important paper no less than ten genera and sixty-six species are introduced to scientific knowledge. Among these are two genera and twelve species of Selachians, of which group nine genera and sixteen species occur; two new species of the Pycnodont genus Palæobalistum, and two forms having some affinity with Amia; several new Berycidæ; two species of Platax; a small flying-fish; a Fistularid, and several Salmonidæ and Clupeidæ; also, *Xenophilis carinatus*, six species of Rhinellus and two species of Anguilla, the first Mesozoic eels yet known,—are among the Teleosteans.

GEOGRAPHY AND TRAVEL.[1]

AFRICA.—THE EASTERN DESERT OF EGYPT.—"Notes on a Sketch Map of Two Routes in the Eastern Desert of Egypt" is an interesting account of the scenery, etc., of a little-known part of Egypt proper, viz., the stony desert lying between the Nile valley and the Red Sea. The desert rises from the Nile for about a hundred miles, where the elevation is 2,000 feet, and thence shelves more sharply to the Red Sea. The Red Sea slopes are blessed with frequent rainstorms; waterfalls, crystal pools, fern-clad grottoes, even trees, can be found in the wadis or valleys which seam their sides, and even the Nile slope has its picturesque ravines and tree-sprinkled nullahs. The inhabitants of the district are the Ma'aze tribe of Bedawin, who live in goats'-hair tents, to the north; and the more civilized Ababdi to the south. This Eastern Egyptian desert was probably the scene of the first monasteries in the world. Those of St. Anthony and St. Paul, about nine miles apart, and situated about seventeen miles from the coast, in latitude 29°, are still visited by travelers.

Almost the entire traffic between Rome and India passed, two thousand years ago, along the old trade route between Kosseir, on the Red Sea, and Koptos (modern Kuft), on the Nile. Every five or six miles along the route a more or less ruined khan exists. In the Messägh El Bagar are quarries, once worked by the ancient Egyptians, and bearing inscriptions by the Persian conquerors. Roman stations exist, one of them is Saghi or Naka'al Teir. Ibex are abundant, choosing for their home the wildest and most inaccessible mountains.

THE RAIAN MOERIS.—Mr. Cope Whitehouse sees in the Raian basin the Lake Mœris of ancient geographers, and states that surveys carried out under his direction by the authorization of the Egyptian government, prove that the area can again be converted into a storage reservoir for the surplus waters of the Nile. The number of reclaimable acres in Lower Egypt is given at about five millions; and the surface of the Wadi Raian, at 20 metres above the Mediterranean, at 346,000,000 metres, with 25,540,000 metres of contents. Colonel Ardah states that there are no engineering difficulties in the way of utilising this large basin.

PHYSICAL GEOGRAPHY OF FERNANDO PO.—Petermann's Mitteilungen contains an account of the physical geography of Fernando Po, by Oscar Baumann, a member of Dr. Lenz's expedition. The island

[1] Edited by W. N. Lockington, Philadelphia, Pa.

is one of a volcanic group which may be regarded as the result of an eruptive fissure extending southwest from the Cameroons mountains to the island of Anno Bom, or even further, and seeming to find in the Rumbi mountains a continuation in the heart of Africa. The volcanic peak O-Wassa or Clarence Peak, 10,030 feet in height, almost entirely covers the northern half of the island. West and northwest this mountain is cut by deeply eroded gorges ending in a narrow belt of flat country; to the north and northeast the sides slope gently to a precipitous rocky coast; on the east the precipitous slopes end in a grassy plateau about 1,300 feet above the ocean, while on the southwest there is a gradual descent to the plateau of Batec, which connects O-Wassa with the southern mountain system. The crater is 575 feet deep. The southern mountains for the most part present an almost perpendicular front to the sea. They form two chains and are basaltic. A volcanic mass south of these ranges has what appear to be remains of craters. The principal river is the Uaya or Shark. Few of the rivers rise at a height of more than 2,000 feet.

ASIA, ETC.—THE TRANSCASPIAN OASES.—The mountainous part of Transcaspia, according to M. A. Konschin, is bounded west, north and east by an interminable sand and salt desert, which is rapidly advancing over the mountains and gaining upon the zone of alluvial soil formed by the erosion of the mountains. A tract of country of this recent "loess," extends from Kizil-Arvat to Sarakhs, and equals in area the Khiva oasis, though from lack of running water it forms a dreary contrast to it.

THE CAUCASUS.—Though Elbruz is still the monarch of the Caucausus, several peaks are now known to exceed 16,000 feet. Among these are Tetnuld (16,700 feet), recently ascended by Mr. Douglas Freshfield; a peak climbed in 1886 by Mr. Dent and Mr. Donkin (16,550 feet by their estimation); Schkara and Djanga, which Mr. Freshfield estimates respectively at 17,200 and 16,900 feet, and the Koshtantau, 17,096, and Dychtau, 16,925 feet, of the Russian maps. Mr. Freshfield states that travel in this region of grand mountain scenery is now quite safe.

ASCENT OF THE OWEN STANLEY RANGE.—Messrs. C. H. Hartmann and G. Hunter have succeeded in reaching the summit of the Owen Stanley, the principal range of mountains in British New Guinea. Twenty-seven friendly natives accompanied them in the ascent. Some difficulty, which was peaceably overcome, was encountered with a tribe which guards the great mountain Paramagoro, believed to be the abode of the spirits of the departed. It rained nearly all the time the party were on the mountains. The flora was magnificent in the extreme. It does not appear that the highest summits were reached.

DISCOVERIES IN NEW GUINEA.—Two new rivers, named by their discoverers the Jubilee and the Douglas, have been found and mapped by the exploring party sent out on the *Victory* by Messrs. Burns, Philp & Co. Very few natives were met with, except upon the sea-coast, and these were not particularly hostile. The Douglas was followed to Bowden junction, from whence the eastern tributary (Philp River) was taken until a point was reached about 100 miles up the stream and 25 from the German boundary. The Aird River was found to be but one of the mouths of the Douglas. The Jubilee River opens into Deception Bay, at the head of the Gulf of Papua, about half a degree west of the mouth of the Douglas, and trends northwestward toward the Albert Victor Range. It, also, was followed for about 100 miles. The entire coast region here is very swampy, with dense undergrowth, but the interior is a hilly wooded country. Cretaceous limestone was met with on the Philp River, while basaltic rocks occurred still higher up, and were also met with upon the Jubilee. Both rivers have several mouths, their deltas covering about 40 miles respectively. The natives gave indications of Dravidian origin. Their canoes were dug-outs with outriggers, and often large. They wore nose-pencils, and distended the lobes of the ears.

GEOGRAPHICAL NEWS.—Dr. A. Meyer, of Leipzig, who has recently succeeded in ascending Kilimanjaro to the glacier-walled crater-summit of Kibo, and has explored the volcanic plateau which lies between Kibo and Kimawenzi, estimates the altitude of the former at 19,680 feet, instead of 18,800, as believed by Johnston, who reached 16,000 feet.

M. Sibiriakoff has again despatched the steamer Nordenskiold to the Yenisei *via* the Kara Sea. The vessel left Norway in August, and reached the mouth of the Petchora, where she received a cargo of skins, corn, tallow, and mammoth tusks. The Phœnix of Leith succeeded in entering the Yenisei itself.

From accounts received from various parts of the Arctic Seas of the state of the weather and the ice during the past summer it appears that the steady and continuous prevalence of easterly and northeasterly winds forced the ice from the regions north of Spitzbergen and Nova Zembla down into the seas around Northern Norway, Jan Mayen, Iceland, the Faroë Islands, and the east coast of Greenland. This is thought to account for the early setting in of winter experienced in England.

Dr. H. V. Jhering has voyaged up the Cainacuam, a river in the Brazilian province of Rio Grande do Sul, from its delta to the town of S. Jose. Throughout its lower course the river winds in sharp curves, and while the right bank is steep and wooded, the left is flat and covered with gravel. Higher up both banks

are wooded, and slope gently. Dr. Jhering's map (Petermann's Mitteilungen) shows that the Cainacuam has five mouths, while that of the government engineer (1882) shows but three. Many valuable woods occur in the forests. The "campos," or open tracts, which are invariably higher than the forest-covered country, are referred by Dr. Jhering to the diluvial period, while the wooded lands are alluvial.

M. von Fetvelde, in a "Notice" upon the Congo Free State, gives its area at 1,075,000 square miles.

MINERALOGY AND PETROGRAPHY.[1]

Petrographical News.—The volcanic bombs from the Lake Laach district are divided by Hubbard[2] into four classes—old crystalline and schistose bombs, sanidinite bombs, trachyte bombs, and basalt bombs. The last three varieties are difficult to separate from each other, but are easily distinguishable from the first class. After discussing very briefly the various theories proposed to account for these bodies, the author proceeds to investigate those in which *nosean* occurs. He examines two hundred and sixty thin sections of nosean-bearing bombs, and reaches the following conclusions: (1.) The Nosean is in greater part a druse mineral. (2.) The inclussion so characteristic of this mineral consist of magnetite, either fresh or slightly altered. (3.) The little red octahedra so frequently accompanying the titanite of the Lake Laach bombs is closely related to the pyrrhite of San Miguel, and has probably been derived by the alteration of titanite. Several other points of interest in relation to the minerals occurring in these bombs are noted. The most important results reached, however, are those which have been mentioned. —The elæolite-syenite from the vicinity of Rio de Janeiro, Brazil, has recently been carefully examined by Fr. Graeff.[3] The mass of the rock is described as possessing a holocrystalline hypidiomorphic structure. Its principal constituents are hornblende, orthoclase, elæolite, augite, and mica. The feldspar is noticeable for the possession of a parting[4] parallel to $7\ P\bar{\infty}$. In other cases it is intergrown with very fine lamellæ of plagioclase, thus showing striations when examined under the microscope in polarized light. The elæolite is generally fresh, but in some instances is altered into sodalite and analcite. The accessory minerals are titanite, apatite, zircon, fluorite and a black garnet. The rock is interesting, as affording another example of the predominance of hornblende

[1] Edited by Dr. W. S. Bayley, Madison, Wisconsin.
[2] Min. u. Petrog. Mitth., viii., 1887, p. 356.
[3] Neues Jahrb. f. Min., etc., 1887, ii. p. 222.
[4] cf. W. Cross, Monog. xii. U. S. Geol. Survey, p. 348. Mr. Cross finds a parting in the sanidine of the Leadville rhyolites, which is parallel to $\frac{15}{2}\ P\bar{\infty}$.

over augite in elæolite-syenites. In it are many little veins of a finer-grained elæolite-syenite, which show very clearly the effects of pressure, and which are remarkable for the number of accessory minerals they contain. A second variety of the rock, found as blocks in the Rio de Ouro, consists of elæolite, orthoclase, ægirine and mica, together with a large number of accessory constituents. Among the latter are *rinkite* and *lavenite*. The former[1] occurs in long narrow plates, marked by cleavage lines parallel to their longer axes. The mineral is slightly pleochroic in yellow tints. The plane of its optical axes is perpendicular to the cleavage. It is readily attacked by concentrated hydrochloric acid, with the separation of gelatinous silica. The lavenite[2] occurs in highly refractive, strongly pleochroic, honey-yellow crystals, and is closely associated with the magnesium-iron constituents. A third variety of the Elæolite-syenite is porphyritically developed. It occurs in the form of a dyke in the holocrystalline rock described above, and contains inclusions of a finer-grained rock of the same general nature.—The massive rocks of the Leadville Region, according to Mr. W. Cross,[3] comprise quartz porphyries, rhyolites, audesites, porphyrites and diorites. The porphyries are the most interesting, in consequence of their relation to the ore bodies. They are divided by Mr. Cross into several varieties, each of which is carefully described. That phase known as the Lincoln porphyry is noteworthy, as containing the rare accessory *allanite*.[4] The sanidines of some of the rhyolites possess a peculiar satiny lustre, due to fine partings parallel to $\frac{15}{2}$ $P\bar{\infty}$. The cavities of these rocks are covered with little crystals of sanidine, quartz, biotite and topaz. In the porphyrites biotite is frequently found in tiny green flakes, with a very strong pleochroism, and rounded grains of quartz are sometimes surrounded by an aureole of quartz and feldspar. It is interesting to note that in certain cases epidote is the final product of alteration of all the minerals of the porphyrites, while in other cases this final product is muscovite.—J. F. Williams[5] has recently described, in a very finely illustrated paper, the trachytes composing Monte Amiata, in Tuscany. These trachytes by alteration yield products which approach very closely to rhyolite on the one hand, and on the other appear very like andesites. The paper is enriched by numerous analyses of feldspar, hypersthene, and types of trachyte.—In a late number of the *Neues Jahrbuch fur Mineralogie*, Reusch[6] illustrates, in a very beautiful manner, the effects of pressure on sedimentary and massive rocks. In the case of conglomerates, he shows how a schistose structure may be induced which is entirely distinct from the bedding due to sedimentation.

[1] Cf. American Naturalist, 1884, p. 1141.
[2] Ib., 1887, p. 850.
[3] Monog. U. S. Geol. Survey, xii., Washington. p. 319.
[4] Cf. American Naturalist, 1885, p. 1098.
[5] Neues Jahrb. f. Min., etc., Beil. Bd. v., 1887, p. 381.
[6] Ib., v., 1887, p. 52.

METEORITES.—J. Bosscha[1] describes a meteorite which fell at Karang-Modo, on the island Java, on the 3d of October, 1883. Its thin sections show well-crystallized chondra in addition to enstatite, olivine, troilite, iron and glass. After describing the structure of the meteorite in detail the author proceeds to discuss the various theories which have been proposed to account for the origin of these bodies. He shows the weakness of each, and immediately suggests a new one, in which meteorites are regarded as made up of little particles of cosmic substances, which together with the sun, planets, etc., compose the solar system. He shows how this substance might unite and give rise to a meteorite with the brecciated structure so frequently noticed, and concludes by giving several reasons for the acceptance of his theory.—A meteoric stone which fell at Angro des Reis, in Brazil, during 1867, contains a calcium-rich red augite as one of its constituents. It is consequently richer in calcium than any meteorite heretofore described. It belongs about midway between Rose's eukrites and howardites. Ludwig and Tschermak[2] propose to establish a new class of meteorites, of which this shall be the first member. They call it the augrite class.—A lithosiderite,[3] found last March in a field eight and a half miles west of Rockwood, Cumberland county, Tenn., consists of about 16 per cent. of metallic iron and 84 per cent. of a stony portion made up of anorthite and enstatite. The metallic grains are evenly distributed throughout the mass, and when polished and etched show the usual figures. The stony part presents a brecciated appearance. Through it are scattered the metallic nodules mentioned above, and others consisting of an iron-rich enstatite. It is unfortunate that the careful analyses of the constituent portions of this meteorite are unaccompanied by descriptions of its thin sections.—A meteoric stone having the composition given below is mentioned by Daubrée[4] as having fallen at Djati-Pengilon, in Java, on the 19th of March, 1884. Its specific gravity is 3.747. Weight, 166 kilograms. Composition:—

Fe (Ni=10.78)	Troilite.	Olivine.	Bronzite.	Chromite.
21.3	5.1	33.4	39.0	0.1

It is the fourth meteorite known to have fallen in the neighborhood at various times.—Daubrée and Meunier[5] have examined pieces of meteoric stones, picked up after a meteoric shower which occurred near Grazac and Montpelegry, in Tarn, in August 10th, 1885. They regard them as new types of carbonaceous meteorites. On account of the scarcity of material a complete chemical examination was not attempted. A few tests, however, showed the presence

[1] Neues Jahrb. f. Min., etc., Beil. Bd. v., 1887, p. 126.
[2] Min. u. Petrog. Mitth., viii., 1887, p. 341.
[3] Amer. Jour. Sci., Nov., 1887, p. 387. J. E. Whitfield.
[4] Comptes Rendus, civ., 1887, p.
[5] Ib., p. 1771 and 1813.

of sulphides, chlorides, olivine, a magnetic ingredient and carbonaceous matter.—Quite a large number of short papers recording the results of the analyses of meteoric irons have recently appeared in the journals. Mr. G. F. Kunz[1] has described the tenth meteoric iron actually seen to fall. Its fall took place on March 27th, 1886, at Cabin Creek, Johnson county, Ark.—The same author reports[2] the analysis by Mr. Whitfield of a meteor from Scottsville, Allen county, Ky.—A mass of meteoric iron[3] ploughed up three years ago in a field in St. Croix county, Wisconsin, shows cubically arranged Widmanstättian figures, very much like those characterizing Meunier's jewellite group.—The Taney county, Missouri, meteorite and the meteoric irons from Chattooga county, Georgia, from Eastern Tennessee, from Waldron Ridge, and from Claiborne county, Tennessee, are briefly described by Mr. G. F. Kunz.[4]—A pallasite found at Campo de Pucará, in the State of Catamarca, of the Argentine Republic, is very similar[5] in aspect and mineralogical composition to the pallasite of Imilac, Atacama.

New Books.—The fourth and fifth parts of Professor von Gümbel's "Grundzüge der Geologie"[6] have just been received. They complete the first volume of the author's "Geology of Bavaria." In the two parts before us historical geology is completed. In addition to this there is an interesting chapter on the history of the development of the earth as a portion of the universe and as a member of the solar system. The high character of the illustrations, noticed in former reviews, is maintained, and the number of references is still further increased. The entire volume, exclusive of index, contains 1087 pages, 504 illustrations, and references to 414 topics.—Another very welcome addition to geological literature has appeared in the concluding part of the second volume of Roth's "Chemische Geologie."[7] This brochure embraces in its treatment the crystalline schists and the sedimentary rocks. Like the earlier portions of the same volume, this part is especially valuable for the copious references to articles relating to the spread and character of these important classes of rocks—classes which have hitherto been neglected by writers of handbooks of petrography. The lists of localities in which the different members of these great classes of rocks are found, is very full, except in the case of North America, where it seems that many localities have been overlooked. The book, however, is one which no geologist can well afford to be without.

[1] Amer. Jour. Sci., June, 1887, p. 494.
[2] Amer. Jour. Sci., June, 1887, p. 500.
[3] D. Fisher: ib., Nov., 1887, p. 381.
[4] Ib., Dec., 1887, p. 467.
[5] E. Cohen: Neues Jahrb. f. Min., etc., 1857, ii., p.45.
[6] Geologie von Bayern., Bd. I. Lief iv. v. Grundzüge der Geologie. Dr. K. W. von Gümbel. Kassel, 1887. Cf. American Naturalist, 1886, p. 1047.
[7] J. Roth: Allgemeine und Chemische Geologie, Bd. II. Abt. 3. Berlin, 1887. Cf. American Naturalist, 1885, p. 1215.

MISCELLANEOUS.—Kroustschoff[1] has obtained little crystals of biotite by heating to a high temperature a mixture composed of basalt glass (fused basalt and acid rocks), biotite fragments, amorphous silica, potassium silico-fluoride and sodium and aluminium fluoride.—By fusing tin stone with sodium carbonate and sulphur at a low temperature, for five or six hours, Genth[2] finds that little pyrite crystals are formed.—Alabandine is a regularly crystallizing manganese sulphide. It has been produced artificially by Baubigny,[3] by heating in a sealed tube to 100° the pink precipitate produced when hydrogen sulphide is passed through an acetic acid solution of manganese.—"Precious Stones in the United States" is the title of a very readable article, by G. F. Kunz,[4] in the December number of *Harper's New Monthly Magazine.* It is illustrated by a full-page lithographic plate of the most important gems found within the border of the United States.

BOTANY.[5]

SCHRŒTER'S ARRANGEMENT OF THE USTILAGINEÆ. — In Cohn's Kryptogamen-Flora von Schlesien, Schrœter divides the order Ustilagineæ into three families, as follows, viz. :—

I. *Ustilaginacei,* containing the genera Ustilago Pers., Sphacelotheca De Bary, Schizonella Schrœter, Tolyposporium Woronin.

II. *Tilletiacei,* with the genera Tilletia Tul., Urocystis Rabenh., Entyloma De Bary, Melanotænium De Bary, Tubercinia Fr., Doassansia Cornu.

III. *Thecaphorei,* with the genera Schrœteria Winter, Thecaphora Fingerh., Sorosporium Rudol. The genera Graphiola Poit., Entorrhiza C. Web., Piapalopsis J. Kuhn, and Tuberculina Sacc. are added in an appendix as doubtful Ustilagineæ.

SCHRŒTER'S ARRANGEMENT OF THE UREDINEÆ.—Schrœter divides the fruit-forms of the Uredineæ (in Cohn's Krytogamen-Flora v. Schlesien) into two classes, viz. : (1) Fore-fruits or first-fruits (*Vorfrüchte*)—including (a) Spermogonia, (b) Æcidia, (c) Uredo—and (2) Last-fruits or after-fruits (*Endfrüchte*), including the teleutospores. The order Uredineæ he divides into five groups, as follows, viz. :—

I. *Pucciniei,* including the genera Uromyces Lk., and Puccinia Pers.

[1] Min. u. Petrog. Mitth., ix., 1887, p. 55.
[2] Contributions from the Chemical Laboratory of the University of Pennsylvania, 1887, p. 5.
[3] Comptes Rendus, civ., May, 1887, p. 1372.
[4] December, 1887, p. 97.
[5] Edited by Prof Chas. E. Bessey, Lincoln, Neb.

II. *Phragmidiei,* including Trachyspora Fkl., Triphragmidium Lk., and Phragmidium Lk.

III. *Endophyllei,* including the single genus Endophyllum Lev.

IV. *Gymnosporangiei,* with the genus Gymnosporangium Hedw.

V. *Melampsorei,* including Melampsora Cast., Melampsorella Schröt., Calyptospora J. Kuhn, Coleosporium Lev., Chrysomyxa Unger., and Cronartium Fr.

Tumble-weeds Again.—The latest addition to the lengthening list of tumble-weeds is *Corispermum hyssopifolium* L., which in northern Nebraska assumes the globular form now so well known as characteristic of the tumble-weeds, and late in the season gives itself to the winds. Fine specimens were brought to me in September, 1887, by a correspondent from Long Pine, near the Niobrara River.

In this connection, it may be well to direct attention to the account given by R. M. Christy, in his "Notes on the Botany of Manitoba," which appeared in the October number of the *Journal of Botany,* of the tumbling habit of *Psoralea esculenta,* the "Indian Turnip" of the prairies: "After flowering, instead of withering away, the plant remains standing, and by the time its seeds are ripe it has become—flowers, stalks and all—perfectly dry, brown and rigid. In this condition it is very light. The stem then separates just below the ground, leaving the entire plant free, to be blown about by the wind over the surface of the prairie, dropping its hard, oval seeds as it goes." Mr. Christy weighed a number of plants and found that, while they averaged six and a half inches in height and bore three flower-clusters each, they had an average weight of but a trifle over thirty grains.—*Charles E. Bessey.*

Botanical Work in Minnesota.—The Report on the Botanical work in Minnesota for the year 1886, which was distributed the 1st of October, 1887, gives one a very good idea of the kind of work which is being done by those constituting the working force of the Geological and Natural History Survey of the State. Professors Arthur and Bailey, with Mr. E. W. D. Holway, made an expedition to Vermilion Lake, where they remained for some time engaged in the critical study of the flora of the region. Other points were visited, and collections were made. The party was composed of experienced collectors, and the results were unusually good. Two of the party were acute students of the fungi and other lower plants, while the third was equally well prepared for special work on Glumaceæ and Amentaceæ, as well as the Phanerogams in general.

The list of specimens collected is a remarkably good one, numbering seven hundred and sixty-two in all. These are distributed as follows:—

Phanerogams	368	**Oöphytes**	11
Pteridophytes	26	**Zygophytes**	45
Bryophytes	42	**Protophytes**	28
Carpophytes	242		

The 227 Dicotyledons are represented by 90 Choripetalæ, 100 Gamopetalæ, and 37 Apetalæ. Of the 135 Monocotyledons, 47 are sedges, and 30 grasses. Of the Carpophytes, there are 77 Hymenomycetes, 39 Uredineæ, 36 Lichens, 57 Pyrenomycetes, and 21 Helvellaceæ. The Zygophytes are mostly Desmids (31 species) and Diatoms (12 species), while 19 of the Protophytes are Slime Moulds.

The specimens upon which the entries are made are all preserved in the Herbarium of the Survey, a precaution well worthy of general imitation.—*Charles E. Bessey.*

Botanical News.—Dr. Farlow describes in the September *Botanical Gazette* an Æcidium on Red Cedar, to which he gives the name of *Æcidium bermudianum.*——Coulter and Rose continue their useful studies of the Umbelliferæ in the October and November numbers of the same journal.——Dr. T. F. Allen appears again in the pages of the *Torrey Bulletin* for October with a paper on Characeæ, accompanied by five plates. Two new Nitellæ and one Tolypella are described.——The November and December numbers of the *Journal of Mycology* are principally filled with Dr. J. W. Eckfeldt and M. W. Calkins' Lichen Flora of Florida, being a catalogue of species, with notes, and also notices of new species.——Part 3 of Professor Greene's *Pittonia* contains an excellent biographical notice of the late Dr. Albert Kellogg, well known for many years as a collector and student of the Pacific coast plants. The editor, in an article on Echinocystis § Megarrhiza, insists strenuously that the older name of *Mara* should be used instead of Megarrhiza.——The Californian Manzanitas received the attention of Dr. C. C. Parry in a paper read before the California Academy of Sciences. They belong to the Uva-Ursi section of the genus *Arctostaphylos,* and number twelve species in all.——R. P. Bigelow's paper on the Structure of the Frond in *Champia parvula,* read before the American Academy of Arts and Sciences, now issued as a reprint from the "Proceedings," is a careful study of the structure of this member of the Florideæ.——The Development of the Ostrich Fern (Onoclea struthiopteris), by D. H. Campbell, being the "Walker Prize Essay" for 1886, has been printed in the Memoirs of the Boston Society of Natural History. It is accompanied by four good plates.——The Bulletin of the Illinois State Laboratory of Natural History, lately issued, contains an important contribution to our knowledge of the Erysipheæ, by Professor Burrill and F. S. Earle. The Illinois species are carefully described, and the synonymy has received close attention. Several

changes have been made in the names of common species.——J. G. Baker continues his synopsis of Tillandsieæ in the November *Journal of Botany*, reaching No. 112, with the article to be continued. In the December number of the same journal Otto Nordstedt points out that a great many of the figures in Cooke's British Dermids are copied from Ralfs, Archer, Brébisson, De Bary and many other authors, in spite of the statement that "the greater part of the figures have been drawn direct from the specimens themselves." We must suppose that the artist imposed upon the author in this case.——G. Massee publishes in the December *Grevillea* a revision of Polysaccum, admitting eight species, of which two, *P. pisocarpium* and *P. turgidum* are American.

ENTOMOLOGY.[1]

THE HOP PLANT-LOUSE, *Phorodon humuli*.—An important contribution to our knowledge of the life of this species was made during the year just closed, by the Entomologist of the U. S. Department of Agriculture. Professor Riley, assisted by Mr. Pergande, Mr. Howard, and others, very carefully traced the transformations of the species throughout one complete cycle, *i.e.*, from the winter eggs of one year to those of the year following.

The most interesting result of these investigations is the confirmation in a striking manner of the previously known fact that this species passes the winter on plum trees.

It is urged by Professor Riley that this is the only mode of hibernation of the species, or at least that it does not winter on the hop. This is a point of the highest practical importance, and one which must be settled before a complete plan of defence from the ravages of this pest can be matured. Unfortunately, the evidence adduced by Miss Ormerod in her report for 1884, and indicating that one form of this species winters on the roots of hops, is too strong to be set aside by anything yet advanced.

The following is a résumé of the transformations of this insect, as determined by Professor Riley, and published in advance of his annual report[2]:—

"As soon as plum leaves put out in spring, the first generation of lice hatch from the winter eggs on plum. These are wingless agamic females, giving birth to young like themselves without the intervention of males. The third successive generation upon plum, however, is winged, not wingless, and the first fledged individuals

[1] This department is edited by Prof. J. H. Comstock, Cornell University, Ithaca, N. Y., to whom communications, books for notice, etc., should be sent.

[2] L. O. Howard, The Cultivator and Country Gentleman, November 17, 1887.

of this generation the present season were observed June 4. The individuals of this winged generation migrated at once to the hops, settled and began giving birth to the fourth generation, which consisted, as did the second, of wingless, agamic females. The fifth, sixth, seventh, eighth, ninth, tenth and eleventh generations followed, and were all composed, as was the first, of wingless agamic females, bringing observations in point of time down to the last week in August, or close to the commencement of hop-picking.

"The last week in August the offspring of the eleventh generation (themselves the twelfth) showed rudimentary wings, and at the same time the offspring born the previous week from the still living females of previous generations (as far back as the fifth) also showed plainly that they would become winged. August 26th the first winged females were observed at Cooperstown, and August 31st at Richfield Springs, the main locality for observations. September 2d they had already flown in small numbers to both Damson and wild plum, and had begun to deposit larvæ, which may be called the normal thirteenth generation. From day to day the winged lice increased in numbers until on the 13th of September the air was literally full of them, flying from the hop fields and settling on every variety of plum, and upon every available plum leaf. They were found a mile distant from any hop plant, searching for some plum tree on which to settle and bring forth young. Standing in front of a plum tree and facing toward a neighboring hop yard, Mr. Pergande observed a swarm coming from the hops and settling upon the plum. A most interesting point in this connection is the fact that none of these winged generations will settle and reproduce on hop. This was proven by careful and repeated experiment. So great were the number and so completely were the plums in certain places covered, that many of these winged females were obliged to settle upon neighboring weeds, where they brought forth young, which, however, died after feeding a few days.

"All of these winged individuals of the twelfth generation which migrated to plum up to September 28th were agamic females. (A few were still flying late in October.) Their young (thirteenth generation), however, attained full growth by this date, and proved to be all true sexual females, wingless. At this time the males were discovered. They proved to belong to the twelfth generation, but only to the very late and much retarded offspring of the retarded agamic wingless eleventh. They developed late in September upon the fragments of hop vines still remaining in the hop fields, and became winged the last week in September, just in time to fly to the plum and mate with the wingless sexual females which became full grown at this time or a little before. Immediately after this mating the eggs began to be deposited, and by October 7th large numbers could be found without trouble on the smaller twigs and branches of plum, in and around the angles formed by the buds and twigs. Each female laid from one to three eggs."

On the Occurrence of Apterous Males among the Aphididæ.—In view of the very few species of American Aphides in which apterous males have as yet been found, it may be of interest to call attention to the occurrence of this form in certain species whose autumn life history I have lately been studying. In *Schizoneura carnicola* this is the only male form produced, and it may be found abundantly during October on the leaves and twigs of various species of *Cornus*, often *in copulo* with the oviparous females. It also occurs in the root form of the corn-plant louse (*Aphis maidis*), having been taken with the oviparous females during October, in ant colonies, about corn roots; and in a species of *Aphis*, found abundantly in certain plants of *Amarantus albus*, during October. In all of these species the male is of the same general form, being slender and flattened, with long legs and antennæ, and very active in its movements.

The only reference to the occurrence of this form in America which has come to my notice is by Professor O. W. Oestlund, in his List of the Aphididæ of Minnesota,[1] in which he records finding it in several species of *Siphonophora*. I presume that when our species are more thoroughly studied it will be found to occur quite frequently. It is to be hoped that the recent progress made in our knowledge of the life-history of the group will stimulate a more thorough study of these much-neglected insects.—*Clarence M. Weed, Ill. St. Laboratory of Nat. History, Champaign.*

The Imported Cabbage Butterfly.—Mr. S. H. Scudder has collected a large amount of data regarding the introduction and spread of Pieris rapæ in North America. This he has very carefully digested and published as one of the Memoirs of the Boston Society of Natural History.[2] This memoir is accompanied by a map showing the centres and annual areas of distribution of the species in North America from its introduction in the East in 1860 to 1886.

The chief points brought out by Mr. Scudder's paper are the following:—

(1.) The insect was first captured in this country in 1860, by Mr. Wm. Couper, near Quebec. "From what we know of the rapidity with which a single pair may propagate, without hindrance from parasites, we may conclude with almost certainty that it was introduced in the early part of 1860, or, at the earliest, at the very close of 1859." This is a later date than is commonly assigned. (2.) In addition to the importation by way of Quebec, the species was introduced independently in New York in 1868, at Charleston in 1873, and at Apalachicola in 1874. These later introductions may have been by means of coasting vessels, or by rail from the North.

[1] Fourteenth Ann. Rept. St. Geol. of Minn., pp. 19–22.
[2] l. c., Vol. iv., No. iii.

(3.) The westward spread of the species was hastened by its spreading from colonies established at Indianapolis in 1874, and at Chicago in 1875. (4.) The species has reached the natural limit to its southern extension. This is shown by the fact that it can hardly maintain itself at Apalachicola and has not pushed its way into the peninsula of Florida beyond, hardly to, Jacksonville, although it has for ten years been within what would elsewhere be not more than a year's flight away.

On the Systematic Position of the Mallophaga.—Dr. Packard reviews[1] our knowledge of the structure of the Bird-lice, and compares them with the Pediculidæ and with the Psocidæ. He concludes that the Mallophaga are nearest allied to the Psocidæ, and are degraded members of the order to which the Psocidæ belong. He divides his order Platyptera into two sub-orders:—

I. Mallophaga.

II. Platyptera genuina: Superfamily 1, Plecoptera (Perlidæ); Superfamily 2, Corrodentia.

The Corrodentia as restricted by Packard above includes the Termitidæ, Embididæ, and Psocidæ.

Entomological News.—Mr. S. H. Scudder published in the Canadian Entomologist for November "Comparative Tables for the Families of Butterflies." The characters of the families are given at great length, and include every stage of life. Bulletin No. 3 of the State Entomologist of Illinois is a Contribution to a Knowledge of the Life-History of the Hessian-fly, by S. A. Forbes. A list of the entomological writings of Dr. A. S. Packard, with a systematic and general index, prepared by Mr. Samuel Henshaw, forms Bulletin No. 16 of the division of Entomology of the U. S. Department of Agriculture; 339 titles are enumerated.

ZOOLOGY.

Contribution to the Fresh-Water Rhizopods.—During the last season some investigation was made for Rhizopods to illustrate this important group of animals before my pupils in Zoology.

Gatherings, from sphagnum swamps, the ooze of springs, ponds and sheltered coves along the Penobscot River near Orono, were examined.

By consulting Dr. Leidy's Rhizopods of North America the following species were determined.

[1] American Philosophical Society, September 2, 1887.

The majority of the species enumerated occur in a sphagnum swamp on the College farm. The list represents the observations of a single season, and will, of course, be extended by closer research.

References to figures and plates refer to Dr. Leidy's Rhizopods of North America.

ORDER PROTOPLASTA.

Amœba proteus, Leidy. Page 30, Pl. 1.

Widely distributed in sphagnum swamps, the ooze of springs, ponds and sheltered coves along the Penobscot. Not plentiful in individuals, but widely distributed. Quite variable in size.

Amœba radiosa, Ehrenberg. Page 58, Pl. 4.

Observed in the water of a sphagnum swamp on the College farm. Two individuals were seen which assumed forms like Figs. 1, 3 and 6, Pl. 6. Changing slowly from the spherical form, and protruding a variable number of pseudopodia from one to several.

Amœba villosa, Wollich. Page 62, Pls. 1, 2, 7.

Several specimens of the general form of Figs. 8 and 9, Pl. 5, were seen in the water of a spring on the College farm, associated with other Rhizopods.

Difflugia globulosa, Du Jardin. Page 96, Pls. 15, 16.

Forms like Figs. 8 and 9, Pl. 16, are not uncommon in sphagnum swamps about Orono.

Difflugia pyriformis, Leidy. Page 98, Pls. 10–13, etc.

Quite common in sphagnum swamps in the Penobscot Valley. Variable in form.

Difflugia ascula. Page 116, Pls. 15, 16.

Forms in outline like Fig. 31, Pl. 16, were seen, but the triangular orifice in most had sides more nearly straight than Fig. 30. Not scarce in sphagnum swamps. This form is probably only a variety of D. lobostoma.

Hyalosphenia papilio, Leidy. Page 131, Pl. 21.

This handsome species is very common in the water of sphagnum swamps. Forms like most of the Figs. of Plate 21 were observed, and also another form, of which several specimens were seen, that is not figured by Dr. Leidy. This variety has the general outline of the normal form, but is abruptly narrowed at the minute orifices shown on the sides of Fig. 7, Pl. 21. The outline of variety lobata is given in Fig. 1, which shows the extreme of constriction. Intermediate forms seem to connect this with the normal form. The color of the test and sarcode contents of the variety is the same as in the normal form. The sarcode in all the forms observed was encysted, and composed largely of green corpuscles. The normal form is very abundant.

Hyalosphenia tincta, Leidy. Page 138, Pl. 20.

Forms like Figs. 11 and 12, Pl. 20, are not uncommon in sphagnum swamps, associated with H. papilio and H. elegans.

Hyalosphenia elegans, Leidy. Page 140, Pl. 20.

This beautiful species does not seem to be so common as H. papilio, but is quite plentiful.

Nebela collaris. Page 145, Pls. 22–24.

The specimens observed from one sphagnum swamp were in form like Fig. 17, Pl. 22, but sculptured more like Fig. 14. Other specimens like Fig. 14, with encysted sarcode, were seen.

Nebela flabellum, Leidy. Page 152, Pl. 23.

Forms like Fig. 18, Pl. 23, are not uncommon in sphagnum waters about Orono.

Heleopera pieta, Leidy. Page 162, Pl. 26.

Forms like Fig. 8, Pl. 26, are rather plentiful in sphagnum waters about Orono.

Arcella vulgaris, Ehrenberg. Page 170, Pls. 27, 28.

Clear individuals like Fig. 4, Pl. 27, were seen, also dark-colored forms flattin in shape, but probably referable to this species.

Arcell discoides, Ehrenberg. Page 173, Pl. 28.

The specimens observed were like the clear individual, Fig. 29, Pl. 28. No colored forms were seen.

Centropyxis aculeata, Ehrenberg. Page 180, Pls. 30, 31, 32.

Forms like Fig. 30, Pl. 32, with five spines, somewhat more slender and shorter, were in a gathering from a sphagnum swamp on College farm.

Campascus. New variety.

Forms like Figs. 2 and 3 in outline are not uncommon in sphagnum water. The shells are brownish and membranous, and, so far as observed, probably empty. They have the best neck of Campascus, but differ very much in the emorginoli fundus from C. cornutus. The specimens are about the same size as C. cornutus, but somewhat variable, as shown by figures. There is nothing like it figured in Leidy's Rhizopods. It is probably another form of this polymorphous species.

Englypha alveolata, Du Jardin. Page 207, Pl. 25.

The typical forms common in springs and also sphagnum water about Orono.

Englypha ciliata, Ehrenberg. Page 214, Pls. 35, 36.

Spineless forms like Fig. 23, Pl. 36, found in sphagmoss in a Tamarack swamp.

Ciliated forms like Fig. 20, with plates barely visible, and with two nuclei situated as in Fig. 4, but smaller. Sphagnum swamp, Orono, Me.

The typical forms common in springs, and also sphagnum water about Orono.

Assulina seminulum, Ehrenberg. Page 225, Pl. 37.

Forms like Figs. 15 and 24 are found sparingly in sphagnum moss in Tamarack swamps about Orono.

Trinema enchelys. Page 296, Pl. 39.

Forms like Figs. 46 and 47 are very common in sphagnum water. A form like Fig. 4, with a brown chitnoid membrane, is quite common. In form it is somewhat like Fig. 12, but there is nothing like it figured. It is probably referable to this species. Our specimens were not active, and the pseudopodia not observed.

ORDER HELIOZOA.

Actinophrys sol, Ehrenberg. Page 235, Pl. 40.

Forms like Figs. 1, 2, 3 and 4 were observed in the water of sphagnum swamps, and from pools along the Penobscot River about Orono.

Acanthrocystis chætophora. Page 264, Pl. 43.

Type forms observed, though more filled with green corpuscles than Leidy's figures. Springs swamp, near Orono.—*F. L. Harvey.*

WORMS IN HEN'S-EGGS.—Dr. Edward Linton records (*Proceedings U. S. National Mus.*, 1887) the occurrence of *Distomum ovatum* in the white of a hen's-egg from Berlin, Wisc. "The occurrence of this parasite in the eggs of fowls, while not common, is not difficult to account for. Its favorite place of lodgment in its host is in the bursa of Fabricius. An individual may occasionally penetrate one of the passages which communicate with the cloaca. It is well known that such excursions are sometimes made by this parasite into the oviduct. If it should penetrate beyond the shell-forming glands when an ovum is *in transitu*, it would not be an improbable thing if the parasite should find itself enveloped in the glairy albumen which is being exuded there."

In this connection we may refer those interested to a recent article on two cases of enclosure of nematodes in hen's-eggs which are discussed in Dr. Pelletan's *Journal de Micographie*, xi. pp. 407 *et* 512, 1887.

THE RELATIONS OF THE EUROPEAN AND AMERICAN HELICIDÆ.—Dr. Wilhelm Kobelt, at the Wiesbaden meeting of the Congress of German Naturalists, compared the recent and fossil European Helices with those of America. He showed that while to-day the molluscs of Europe differed greatly from that of Central America, the miocene forms of the former country so resembled those of the Antilles and of North America that the latter might be regarded as descended from the former. He is even inclined to believe in such a genetic connection, which, contrary to that of mammals and plants, has gone from east to west, and claims that a land-bridge between the two continents must have been north of the Sahara, because of the absence of African types in America.

EXCRETORY ORGANS OF SPIDERS.—Some recent investigations of Dr. J. C. C. Loman (*Tijdsk. Nederl. Dierkunde Vereen* i. p. 109. 1886–7) on the so-called Malpighian tubes of spiders are of interest. In sections of a Javanese trap-door spider he finds that these organs differ very materially from those of the hexapods and agree with those of the amphipods, in the fact that they are diverticula of the mid rather than of the hind gut. As to the development of these organs in the spiders almost nothing is known, the two most recent authors on arachindan embryology—Locy and Schimkewitsch—having nothing to offer on the subject. The bearing of the observations of Loman tend to show that these organs are not homologous in all the "Trachcates," and possibly that the arachnids and crustaceans are more closely related than is admitted in most text-books.

THE MYLOHYOID GROOVE IN THE MESOZOIC AND RECENT MAMMALIA.—The Mesozoic Mammalia subdivide into two series, *A*, the *Multituberculata*, a marsupial suborder characterized by tubercular teeth and a pair of very prominent incisors; and, *B*, a less clearly defined group in which the incisors are numerous and subequal in size and the molars are cuspidate. All of the latter, so far as known at present, are characterized by a groove extending along the inner face of the mandible from the orifice of the dental canal, which Owen has called the *mylohyoid* groove, from its possible homology with a similar groove in the human jaw. The Multituberculata entirely lack this groove. Much stress has therefore been laid upon it in the various systems of classification. Owen figures a similar groove in *Myrmecobius*. Dr. Otto Meyer, however, recently called my attention to the fact that the groove is not present in *Myrmecobius*, and threw a doubt upon its taxonomic value. This led to my examining the mandibles of all the marsupials and Primates in the collections of Princeton, Philadelphia Academy and Yale College, with the following results: 1°. A groove similar to the mylohyoid groove of the human jaw is frequently but not constantly present among the primates: *Gorilla savagii* (strongly developed), *Troglodytes niger*, wanting; *Simia satyrus*, faintly developed; *Cynocephalus* (species?), very distinct. 2°. Among the marsupials this groove is even more variable, never very distinct; sometimes present, sometimes absent, in different individuals of the same species: *Myrmecobius*, it is entirely wanting in the two specimens in the Yale College Museum, but this does not prove that it is always absent in this genus; *Phascolomys*, present in half the specimens examined, absent in the remainder; faintly seen in some specimens of *Dasypus* and *Didelphys; Dasyurus*, *Thylacinus* and *Bettongia*, absent in all specimens thus far examined. 3°. In all the above cases this groove extends obliquely downwards and forwards from the orifice of the dental canal. The inferior dental nerve and artery branch at this orifice, part entering the canal,

part extending along the inner surface of the ramus, as the mylohyoid nerve and artery, to supply the mylohyoid and digastric muscles. There is thus little doubt that this groove lodges this artery or nerve in all these recent forms, as it does in man. 4°. In all the mesozoic mammals in which the groove is present it invariably extends from near the orifice of the dental canal, for a greater or less distance, along the inner face of the ramus, sometimes descending rapidly to the lower border (*Phascolotherium*), sometimes reaching the symphysis (*Amblotherium*). From its constant relation to the dental canal and variable development I think there is little room for doubt that this groove lodged either the mylohyoid nerve or artery; at least there is no ground for any other supposition. 5°. *Dromotherium*, from the Triassic, the oldest of the mammals of Series *B*, presents an exception; I cannot discover the orifice of the dental canal in its usual position; the anterior border of the pterygoid fossa is not clearly defined, as in all the Jurassic genera, but gradually closes into a long, narrowing groove, which suddenly terminates in an orifice in the middle of the ramus beneath the last premolariform tooth. It appears as if the inferior dental nerve and vessel may have lodged in the groove and entered the jaw at this anterior point. From all these data I see no present ground for changing the designation of this groove in the Mesozoic mammals, as employed by Owen, but strong reasons for not attaching any great taxonomic value to its presence or absence.—*Henry F. Osborn.*

The Inter-connections of Smooth Muscular Fibres.—Dr. N. Kultschizny states (*Biol. Centralbl.*, 1887) that smooth-muscle fibres are not connected together by the oft-described intercellular cement, but by means of minute protoplasmic fibres, and that between the cells exist intercellular spaces. A similar view has been held and taught for some time by some American histologists, and these even go farther and trace in the existence of these intercellular bridges, the evidence for evolution of all meso-dermal tissues from an epithelium.

The Faunal Relations of Fernando Noronha.—At the meeting of the Linnean Society of London, November 3, 1887 (according to the *Zool. Anzeiger*), Mr. H. M. Ridley gave an account of his natural history collection in Ferdando Noronha. The group of islands in question is in the South Atlantic, one hundred and ninety-four miles east of Cape San Roque. The largest is about four miles long and two miles across at the broadest part. Although chiefly basaltic, phonolite rocks crop up here and there. The cliffs are steep, but otherwise the soil is fertile; there is an absence of sandy bays on the south side. Generally speaking, the specific animal forms differ on the opposite sides of the main island. The indigenous fauna and flora seems to have been

much modified, and in some cases extirpated by human agency. Of mammals, the cat is reported to have become feral, and rats and mice swarm ; Cetacea occasionally frequent the coast. The land birds comprise a species of dove, a tyrant, and a greenlet (Virio). Sea birds are numerous, but by no means so abundant as they were formerly when the island was first discovered. Among the reptiles were found a species of Amphisbæna, a scink (*Euprepes punctatus*), a gecko ; turtles are also frequently seen in the bays. Batrachians and fresh-water fish are entirely absent. One butterfly, a well-known Brazilian species, was plentiful ; but insects, though abundant, were poor in number of species. Two species of Trochi called for remark as having a southern distribution, the remainder of the marine shells, and indeed most of the marine fauna and flora, show affinities to that of the West Indies.

Muscles of Birds.—The researches of the late A. H. Garrod in the line of avian myology, did much to place the classification of birds upon a firm basis, as may be seen in any recent ornithological treatise of value. He showed that the peculiarities of certain muscles could be made of value in indicating the affinities of the different genera families, etc. Garrod's work has recently been presented to the American students in the shape of an illustrated review by Dr. Shufeldt, in the *Journal of Comparative Medicine and Surgery* for October, 1887. Dr. Shufeldt does not discuss the laryngeal muscles, but he adds to the muscles employed by Garrod the dermo-tensor patagii, as well as calling attention to the systematic value of other characters than the mere presence of Garrod's classificatory muscles.

A Gular Gland in the Banded Ant-Eater.—Mr. F. E. Beddard calls attention (*Proc. Zool. Soc.* London, p. 527. 1887) to a remarkable glandular structure just in front of the sternum of the banded ant-eater (*Myrmecobius fasciatus*) of Australia. In the region of the gland the integument is naked and studded with the apertures of the glands of which there are four distinct kinds : (1) sweat glands ; (2) sebaceous glands ; (3) sudoriferous glands ; and (4) a large compound tubular gland. Of these, 1, 2, and 3 are confined to the integument, but the fourth is situated in the connective tissue underlying the dermis. The duct of the last has not been found. Histologically it resembles a sweat gland, and is divided by partitions of connective tissue.

The Mammalia of the Maragha Bed.—A report on this subject by Dr. Kittl is published in the last number of the *Annalen of K. K. Naturhistorischen Hofmuseums*, of Vienna. The species obtained number twenty-two, of which more than half have been previously discovered at Pikermi, near Athens, and the others do not indicate any wide difference of fauna. Among the peculiar

species may be mentioned the rhinoceros, *Aceratherium blanfordi* Lydd, and *Hippotherium richthofeni* Koken. Prominent Pikermi forms are—*Machærodus leoninus* R. & W.; *Palæoreas lindermayeri, Helladotherium duvernoyi* Gaudry; *Mastodon pentelici* Wagn.; *Palhyæna hipparionum* Gerv.; *Hyæna eximia* Wagn., and *Sus erymanthius* R. & W. Dr. Kittl deecribes the Carnivora in the present paper. He finds the following new species: *Machærodus orientalis* K., *Meles maraghanus*, and *Meles polaki*. The Machærodus is one of the smaller forms, allied to *M. megantereon*, but was a formidable animal—as large as a full-sized leopard.

Maragha is in Persia. The horizon is Upper Miocene, or Miopliocene.

Zoological News.—General.—Observations on the structure and distribution of stripe and unstriped muscle in the animal kingdom, conducted by C. F. Marshall, go to show that the striped form is found in the disc of medusæ, but not in Actinia nor in Echinoderms. Some Vermes show moths, as the Arthropoda and the Arachnida possess the striped form; but the Leech and the earthworm are without it, and the mollusca which possess it are those which, as Pecten, move rapidly. An intracellular network is always present in striped muscle-fibre, and this network is developed where rapid and frequent movements have to be performed. The contraction of the striped muscle-fibre is referred by Mr. Marshall to the action of the longitudinal bars of the network, while he considers the transverse fibres as passively elastic, and by their rebound as causative of the relation of the muscle-fibre. The cardiac muscle cells contain a network similar to that of ordinary striped muscle.

Arthropoda.—The development of *Peripatus Novæ-Zealandiæ* is described by Miss Lilian Sheldon in the Quart. Jour. Micros. Soc., Nov., 1887. The species is viviparous; the segmentation resembles that noted by Henking in certain Phalangidæ; and the embryo derives nutriment partly from the yolk within its body, partly from a peripheral layer.

Fishes.—Professor D'Arcy W. Thompson states (Ann. and Mag. Nat. Hist., Sept., 1887) that the blood-corpucles of Myxine, instead of being small and round, like those of Petromyzon, are large and oval, like those of skates or dog-fish.

Polyprion prognathus, the Hapuku of New Zealand, and one of the most esteemed food-fishes of the Southern Hemisphere, is, according to Dr. A. Günther, identical with *Polyprion kneri*, described by Steindachner, from Juan Fernandez. It is therefore widely distributed and antipodal to the only other species known, *P. cernium*. The latter is shown by Lowe (Fish. Madiora, p. 185) to be a deep-sea fish, swimming near the surface when young, but when adult living at depths of 300 fathoms or more.

In one of the numerous ichthyological papers emanating from the Indiana University, Carl H. Eigenmann and Eliz. G. Hughes give a review of the North American species of the genera Lagodon, Archosargus and Diplodus. The first has one species, while the second and third are represented in North America by four and seven species respectively. Mr. Eigenmann also describes *Ophichthys retropinnis,* from Pensacola, Fla.

Miss Rosa Smith bases a new species of Rhinoptera upon a pair of jaws found at Todos Santos Bay, Lower California.

Batrachia and Reptilia.—G. B. Howes (P. Z. S., June 7, 1887) points out the existence, in the larynx of some Salientia, of a structure which he believes to be homologous with the epiglottis of the higher Amniota. These are in the form of two papillate folds, constituting a forward prolongation of the laryngeal mucous membrane. Posterior to these some Anura have also a pair of folds, which Mr. Howes entitles epilaryngeal. The epiglottis is entirely membranous, and has little if any connection with deglutition. It seems to be purely an accessory voice organ. The Batrachian larynx, like the Reptilian, is without a distinct thyroid cartilage. The author gives a list of the species in which the primitive epiglottis, the paired condition of which resembles the initial stage of the development of the organ in the human subject, was observed. Some species of Hyla are without the folds, while they are present in others.

The Bulletin of the Essex Institute, 1887, contains descriptions by Mr. S. W. Garman of the Iguanidæ and Scincidæ of the West Indies, at present in the Museum of Comparative Zoology at Cambridge. No less than twelve species are added to the genus Anolis, each species apparently restricted to a small cirea. The scincoid genus Mabuia is also enriched with three new species.

Mr. Garman has also published a list of the Reptiles and Batrachians of Grand Cayman, an island of the Caribbean Sea, about 200 miles south of Cuba. Grand Cayman is of coral formation, rises but little above the sea, and must have received its land animals from the neighboring islands not so very long ago. An Anolis and a Liocephalus are described as new.

Mr. Garman has recently added to the snakes of the West Indies *Ungualia curta, Dromicus cubensis,* and *D. ornatus, Alsophis pulcher,* and *Trigonocephalus caribbœus.* A small turtle, Cinosternum sp., sent to Cambridge by Professor F. Poey, seems to possess distinct specific characters.

G. A. Boulenger (Ann. and Mag. Nat. Hist., July, 1887) describes several new Reptiles and Batrachians in the British Museum, including an Anniella and a Hyla coper,[1] from Texas; and an Eiemias from the Guinea Coast.

Years ago Dumeril and Bibron described an Australian snake under the name *Furina textilis*. It has been omitted from all recent lists of the reptiles of Australia, upon the supposition that it was based upon the common *Diemenia superciliosa*. Recently, Mr. Froggat has rediscovered the species in the neighborhood of Port Darwin.

Mammalia.—Among the few beaver colonies still existing in Europe is that at Amlid, some distance from Christiansand, Norway. Sometimes as many as a dozen animals may be seen here in the water at one time. Their huts are built close to the shore, and have two stories, one above and the other below the water level. The walls are of timber, the roof of twigs and mud. The beavers have felled all the aspen-trees in the vicinity, and have begun to attack the birches. They cut down trees upwards of eighteen inches across at the root, but do not seem to use the larger trunks. The branches are dragged to the water-side along regular "log-runs," which are cleared of interloping roots. Sentinels are posted to give the alarm in case of danger, when all the animals leave their dwellings for the water.

A new species of Spermophilus (*S. bactrianus* Scully) and *Ellobius intermedius* Scully, are among the mammals collected by Captain C. E. Yate, of the Afghan Boundary Commission.

E. P. Ramsay has recently described three new mammals (*Antechinus froggata, Perameles auratus, and Mus burtoni*) from North West Australia.

Worms.—In the fresh-water Dendrocœlous planariansis an organ which is usually termed the uterus. Ijima regards this as a gland for forming the egg cocoon, and the latest student (Hallez) agrees with him. Hallez regards Ijima's muscular gland as a force-pump to drive the male elements into the cloaca, and that possibly to expel the ova and cocoons. Its resemblance in certain particulars to the bursa copulatrix of the Rhabdocoela is pointed out.

Birds.—Dr. W. A. Haswell, of Sydney, N. S. W., recently read a paper before the Linnean Society on the early stages of the emu, detailing the history of the primitive streak, mesoderm, neurenteric

[1] The *H. arenicola* Cope.

canal and notochord. As the embryology of no member of the Ratitæ or Struthionidæ has ever been studied, Dr. Haswell's work when published will have no little value.

PSYCHOLOGY.

Evolution and Idealism.—The doctrine of idealism is naturally attractive to the minds that believe in mind. To feel that mind is all in all, and is not bound to "low material things," is as agreeable to the metaphysician as it is to the seeker for immortality. Moreover, the doctrine seems to have a certain support from the scientific side. We know that our knowledge of what are vulgarly supposed to be the properties of matter, is not derived from a single sense, and we readily understand that those properties would appear to be greatly modified, were the number of our senses reduced or increased. Moreover, we know from experience of the abnormal or diseased states, both of ourselves and of other men, that the appearances of the objective world may be wonderfully modified by changes in ourselves. The hallucinations of delirium and other forms of mental disorder, are matter of every-day knowledge; and the illusions that may deceive even the healthy mind are equally well known. The question between the realist and the idealist is, what do these facts prove?

They certainly do not prove that a universe which presents in its parts, and therefore in its entirety, the two properties of extension and resistance, has no existence. They certainly do prove that our knowledge of such universe and of its parts is imperfect. It is to remedy this imperfection, and to enlarge our knowledge that many men spend much labor and time. And the knowledge thus acquired and exactly systematized, is called science. The pursuit of science postulates the existence of that which it pursues, not as states of consciousness, but as objective realities. There are reasons for the soundness of this view, which I propose briefly to enumerate.

If a given supposed object be in reality a purely mental state on the part of the subject, a rational cause for the production of that state is wanting. But letting this difficulty pass for the time, and letting it be supposed that there is some apparent undefined cause for such state existent when the subject is present to it, if the phenomenon be only a mental state, so soon as the subject mind betakes itself to some other locality, the supposed cause must cease to exist to that person or subject. To a second person or subject who may remain behind the first, the cause of the mental state does still exist On the departure of the second person, it ceases to exist for him but continues for the third person, and so on. In the presence of these facts, consistency requires one of two conclusions, on the part of the idealist; either he must deny the validity of the mental states

of other men, or he must believe in the Hegelian aphorism, "Existence and non-existence are identical." Some idealists adopt the one, and others the other of these two horns of the dilemma.

But the difficulty is immensely increased when we contemplate the mental lives of the lower animals, with their varied sense organs and media of contact with the so-called material world. We can readily imagine the limitations under which many of them exist through their structural deficiencies; but we cannot so well imagine, though we are compelled to believe in the wonderful acuteness of the perception, and the to us incomprehensible peculiarity of sensation, produced by the various special organs of sense with which many of them are furnished. Think of the tactile sensibility to slight movements of the water possessed by the blindfish of the Mammoth Cave. Think of the sense impressions of which we know nothing conveyed by the antennæ of insects. Think especially of the "other world than ours," in which many of the Mammalia live, in consequence of the high development of the olfactory sense. We can easily perceive the result of the idealistic reasoning on the part of the inferior animals, were they capable of it. To many of them mankind would not exist; to others the sun would be a fiction. Those to whom low tones are imperceptible, would deny the existence of the only vibrations that some other species is adapted to hear.

The idealistic position which denies the existence of matter, results from a process of cancellation of the objective universe bit by bit. One animal after another, and one sense after another, are proven fallible, and so the entire objective superstructure disappears. The realist, on the other hand, adds together all the phenomena derived from all the senses of all conscious beings, thus getting a positive result, where the idealist gets a negative one. Which is the more rational of the two methods? The actual result to thought is, that we learn the insufficiency of each and every sense, but not its impotency. We are instructed that our true policy is to use our senses to the best purpose, and to add to their number, so that the defect of our knowledge may be remedied, and our mental vision enlarged more and more. And this is the mission of science.

But all knowledge, we are told, is relative, and that of the absolute reality we can learn nothing. This doctrine does not necessarily involve idealism, but it is necessarily held by consistent idealists. One can believe in a material universe and still hold that we do not know it absolutely or even truly. And as "we are all poor creatures," many of us are prone to repeat "great is the doctrine" of the Relativity of Knowledge! And the scientist echoes, but in a different spirit, great is the doctrine of the Relativity of Knowledge; yea, great is our Ignorance! Great is *our* ignorance indeed, but not "great is Ignorance!" The scientist does not worship ignorance; he worships knowledge, and his occupation is to increase knowledge. To the responsive intellect and enterprising spirit, the knowledge of our ignorance is the stimulus to unceasing labor. To men of a more

lymphatic temperament the knowledge of ignorance seems to paralyze their lives. But science has done much towards elucidating the order of the universe, and will do more.

Evolution gives the *coup de grace* to idealism of the consistent type. In the gradual unfolding of organic life it sees the two universal facts, subject and object. It sees them interact and influence each other. Under the influence of active, conscious life thousands of tons of substances are transported from place to place and metamorphosed in the process. Under the influence of life, from which consciousness may or may not be absent, thousands of tons of matter have been made into soil, rocks, and living tissue. On the other hand, the objective environment has constrained all living things into rigid modes, and has extinguished millions. In the midst of all this turmoil, consciousness has picked and wound its way, ever gaining in strength and skill, till now we behold man. Of all animals, man controls his environment most completely. He begins by making his own heat and light; he makes his food to grow, and his skin is partly his own manufacture. He does this, and very much more, with infinite pains and toil, and yet some individuals of his species actually deny the existence of this environment, which has compelled him to be what he is!

It is equally competent for the materialist to deny the existence of mind, as for the idealist to deny the existence of matter. The materialist, beholding the imperfection of the senses, may pronounce them to be, one by one, incompetent witnesses, and declare them to be illusions. The mind, which is the product of these impressions, immediate or remembered, falls with them; it is also an illusion. But the fact is, both exist, object and subject, matter and mind. And since matter cannot study mind, mind must study matter, and by so doing grow to more absolute knowledge and greater control of its physical basis, and therefore of itself.

It can now be seen why the study of the "problem of cognition" has little interest to progressive science. Its result is an expression of our ignorance in philosophical form, a proposition which the scientist is not disposed to deny. But when he asks the philosopher "what do you propose to do about it?" and gets the same old story reiterated from the old scholastics to the latest relativist, he turns from such blind guides to his own, and to nature's laboratories, and goes to work. And the theologian applauds the philosopher, and says of the scientist in his prayers, "I thank Thee that I am not as this section-cutter, this bug-hunter, nor even as this bone sharp." But the scientist knows that he holds the key of the situation, and he lets the philosopher and the theologian rejoice themselves, each in his appropriate department of Swedenborg's heaven. The field of Idealism has been well worked out, and we of this age should thank the mighty men of the past for having done it for us. We can now go on with an easier mind in a more profitable pursuit.

Doctor Montgomery's last article in Number 21 of *The Open Court*, states at once the strength and weakness of idealism. Its principal weakness is that it is unable to stand alone without a good strong realistic prop somewhere behind. Thus the Doctor says (p. 587): "The tri-dimensional, hard, colored, sounding, scented, heated matter—fancied by Professor Cope and others to subsist outside consciousness, and believed by them to be directed and organized by such consciousness—is, indeed, through and through, a fictitious entity, consisting of nothing but a set of our own percepts illusively projected into non-mental existence." This looks like pure idealism, but he lets in a "non-mental existence." Now what is this? On page 589 (bottom) he says: "Now the realistic assumption which the philosophy of organization here makes, is indeed, the simplest possible, and is in full agreement with given facts. It supposes that there subsist in nature non-mental existents possessing the power of specifically affecting our individual sensibility, and of manifesting their special characteristics by means of the different conscious states they arouse in us." This is a little more definite, and the Doctor even calls it by its right name, a "realistic assumption." This is quite to my liking, but I cannot perceive how such "non-mental existent" can have less than three dimensions and still exist. And in order to prove to me that mind or consciousness has no control over this tri-dimensional "non-mental existent," Dr. Montgomery must go into further particulars. He must prove to me than an animal does not eat or drink because it feels hungry or thirsty; does not seek shelter on account of weather or temperature; expresses nothing in its voice of pain, desire or pleasure; that the horse does not run because he is whipped, or the bird build because it feels the necessity of laying, etc., etc.

I must here protest against the misinterpretation of an expression contained in one of my earlier articles, which was not sufficiently guarded, it is true, to preclude such misconstruction. It is possible to say correctly that "mind is a property of matter, as color and odor are properties of the rose," without meaning to say that the two properties are such *in the same manner*, as is inferred by my critic (p. 589). My article in Number 19 of *The Open Court* is sufficiently clear as to what I understand by mind as a property of matter, so that it is unnecessary to go into a fuller explanation. Suffice it to say that the conscious and the unconscious properties of matter cannot be confounded by any rational thinker, and that such confusion is entirely foreign to my thoughts. More than one-third of Dr. Montgomery's article Number 5 is thus irrelevant. In the other two-thirds I fail, as yet, to find a definite theory which shall explain the apparent facts of designed movements of animals, differently from that which is held both by physiological science and by popular belief. That is, that the design in them is the direct result of a limited control which conscious states have, or did once have, over the energy and the matter concerned in producing them. —*E. D. Cope,* in No. 23 of *The Open Court.*

Notes on Forster's Tern,[1] *Sterna forsteri* Nutt.—In spending my summer vacation two years ago at Piney Point, Maryland, some ninety miles from Washington, I had abundant opportunity to study the movements of this beautiful bird.

Their elegant appearance, whether flying gracefully over the water in search of their food, or floating jauntily on a drift log, or darting swifty from place to place, makes them very attractive.

I started out one fine morning, on a collecting tramp, and the sun, which had risen clear and bright, gave evidence of a warm, sultry day; but the wind, shifting, scattered the clouds over the sky, and a dull, rather cool day followed. I continued my walk to the river; the receding tide had leit a sand bar high and dry some twenty feet from the shore, and on this I noticed a flock of Forster's terns, which took flight as I approached. I fired, one dropping dead amid the shrill cries of his companions. As the water was very shallow I commenced to take off my shoes and stockings in order to wade out and secure my specimen; but, to my astonishment, the whole flock renewed their cries vociferously and commenced to circle around me, and from me to the dead bird, as if they knew that I was responsible for their companion's misfortune.

As I commenced wading, the birds seemed to ascertain my object, and they, with one accord, began to fly higher and enlarge their circle, and, flying faster than the rest of the flock, the first six or eight separated themselves in single file, and each one while flying, with a strenuous effort, gave the dead bird a push with its feet; each individual of the flock pushed in rapid succession, and soon would have had the specimen beyond my reach if a friendly boat had not come along and rescued it and dispersed the flock.

For a whole flock of birds to act in perfect unison and with one impulse, to remove a bird in the quickest and most effective manner, is certainly a wonderful performance, which can hardly be credited to instinct (as it is scarcely to be supposed that the affection for members of a flock would be as strong for a mate as for their young).—*P. L. Jouy in Field and Forest.* Washington. Vol. II., No. 2. August, 1876, p. 29.

Variations of the Normal Knee-jerk.—The first and most extensive paper in the first issue of the *American Journal of Psychology* is by Dr. W. P. Lombard, and describes the results of more than six thousand experiments made upon himself by the writer. It was found that not only does the extent of the knee-jerk or knee-kick vary according to the force of a blow struck just below the patella, but also in response to stimuli of other kinds. All the

blows were struck by a hammer which struck with a known force, appended to an accurate recording apparatus. The extent of the jerk proved to be an index of the state of the nerves. The first series of experiments showed that the jerk obtained upon rising in the morning was small; that that given after breakfast was, on the average, higher than those at subsequent hours, and that it rose after each meal; also, that the effect of muscular exercise was always to largely diminish its extent. Slight mental fatigue does not seem to affect the knee-jerk, while unusual mental fatigue produced an irritability which reinforced it. Irritation of the skin, voluntary movements, attention to unusual sounds, exciting mental work (such as the recitation of a stirring poem), music (especially of an emotional character), exciting dreams, all increased the extent of the knee-jerk. Violent respiratory movements also increased it, while a rise of temperature or a fall of the barometer diminished it, opposite meteorological conditions producing opposite results. A second series of experiments confirmed the results obtained by the first.

ARCHÆOLOGY AND ANTHROPOLOGY.

THE MAGIC MIRROR OF CHINA AND JAPAN.—The magic mirror is the common toilet mirror or *kagami* in everyday use in Japan. It is a thin disk of cast bronze about eight inches in diameter, or of various sizes, and has a short handle cast with the piece. The plane side is amalgamated; on the back are representations in relief of bamboos, ships, storks, trees, etc., and generally two large characters.

The performance of this mirror has long excited great curiosity and interest, and there have been many ingenious conjectures as to the reason of the strange way of its reflection. The magic is that, when it is properly prepared and the sun's rays caught upon it and reflected on a screen, the outlines of the characters and figures on the back show in the reflection. The figures appear lighter than the rest of the field, and not frequently with a sharp outline. Better results will be obtained if the mirror is slightly warmed, laid on its back on a perfectly flat surface, and briskly polished with a cloth. Then, if the sun's rays are caught upon it, at first in the reflection the figures cannot be seen, but they gradually appear and are permanent. In China its peculiarity has been long and well known, for it was spoken of with great admiration in the eleventh century by Tchin-Kouo, and the poet Kin-ma, celebrated it in verse. It is probably used as one of the very numerous agents of divination practiced there; and in passing, we note that a mirror, the symbol of purity, is found in every Shinto temple and shrine in Japan. The Chinese mirror has no handle; it is held by cords passed through lugs at the back.

They are called in China *theou-kouang-kien*, or mirrors that are penetrated by light, an expression which portrays a popular error. Ou-tsin-hing, who lived between 1260 and 1341, wrote on the subject as follows: "Here is the cause of that phenomenon which proves the employment separately of fine and coarse copper. If they have produced in the founding in a mould a dragon arranged in a circle, on the face of the mirror they engrave deeply an exactly similar dragon. Then, with copper a little denser, they fill up the deep cuts of the chisel, submit the mirror to the action of fire, after which they level and dress the face and give it a light coating of tin. When its image is reflected on the wall, it presents the clear tints and dark tints which proves that the one is of the portions of purer copper and the other of the coarser parts."[1] He claims to have seen a broken mirror which was so constructed. Aside from physical reasons, the cheapness of the *kagami* refutes the idea of this extremely difficult process to make a common toilet article.

An amusing interpretation of the riddle was brought out on questioning several Japanese. They said that magic mirrors are caused by earthquake shocks occurring just when the metal is being poured into the mould; the shock rearranges the particles and alters the reflecting powers. Workmen sometimes jar the flasks to produce the effect during the rare absence of an earth tremor in that land of seismic disturbances. Just how much magic comes from the great fish whose uneasy slumber causes earthquakes, according to Japanese folk-lore, has not been found out.

However, in the course of these inquiries a fact was elicited of some importance. All mirrors are not "magic," and they cannot be "made to order." This may have some bearing on the theory or explanation of Messrs. Ayrton and Perry, English electricians, who have accidentally observed that on amalgamation, or coating with mercury, brass expands. They think this will explain the workings of the mirror, or is a primary cause. Amalgamation would affect the thinner parts made by the pattern more than the rest of the plate, giving it the imperceptible unevenness that becomes plainly apparent in the reflected image.[2] This is the most scientific explanation that has yet been given, and may be tentatively accepted as the best yet offered. Yet it is not improbable that artificial heat, or the heat of the sun, increases the unevenness of the plate by irregular tension relative to the pattern, and is a sufficient cause. That the figures do not come out at once indicates this, and I believe it is not the least factor in the problem. It is given, at any rate, with the hope that it will throw some light on a curious and perplexing catoptric phenomenon.

Since writing this, I notice an article on this subject in the Journal of the Franklin Institute for January, 1888. The author, Mr. Ives, gives much valuable information, and thinks that the

[1] L'Univers, vol. vi.: Chine Moderne, vol. ii. p. 637.
[2] Science, July 2, 1886.

cause is to be found in the elasticity of the plate, making it slightly irregular on grinding.—*Walter Hough,* U. S. National Museum.

Anthropological News.—Ensign A. P. Niblack, U. S. N., has just returned to Washington from a three years' voyage to southern Alaska, where he was engaged on Coast Survey duty, in the steamer Carlisle P. Patterson. Lieut. Niblack is an enthusiastic archæologist and has done good service to that science as the records of the Smithsonian Institution will abundantly show.

He pushes his researches among natives whenever and wherever his duties permit. He returns loaded with ethnologic material, which he will now have the opportunity to classify and describe. He has perfected himself in photography, and returns with full series of Indian villages, houses, totems, burial posts and glaciers, which, jutting into the sea and breaking off, are caught in the act of transforming themselves into icebergs. Lieut. Niblack's interest and studies have been directed to the Totem posts with which that country is so prolific. He says that winter is the only season when studies can be successfully made in the ethnology of Alaska.

The natives are then at their homes prepared to give or receive pleasure or information. In the summer they are engaged sometimes far inland on the mountains and inaccessible.

Mr. E. A. Douglas, of New York, has returned to the United States after two years' absence in Europe.

Mr. Douglas possessess one of the finest private Ethnographic collections in the United States. It was stored for safe keeping during his absence at the New York Museum, Central Park.

Mr. Douglas has now gone to Florida, where he will continue his studies until his return in May. His address is Saint Augustine.

SCIENTIFIC NEWS.

—The Middlesex Institute proposes to publish a Flora of Middlesex County (Mass.), giving a complete list of the Phanerogams and Vascular Cryptogams. In the lower Cryptogams, lists prepared by specialists will be given, as complete as the present state of knowledge permits. The work is based upon botanical researches for many years by members of the Institute, with this publication in view; supplemented by a careful examination of all works bearing upon the subject, and all public and private collections accessible. No plants have been admitted to the list except on evidence of the actual specimen or of competent botanists; and all doubtful questions with regard to identification have been referred to eminent specialists. The publication will be an octavo volume of more than 200 pages.

—The project of a Marine Biological Laboratory on the New England Coast is not languishing. Several thousand dollars have already been subscribed towards the erection of the necessary building and its equipment and maintainance. The committee on the laboratory have arranged a course of eight lectures, the proceeds of which are to be added to the fund. These lectures are as follows:

Jan. 18.—Professor W. H. Niles, of Massachusetts Institute of Technology—"Mountain Sculpture." Jan. 25.—Major J. W. Powell, Director of the United States Geological Survey—"Savagery, Barbarism and Civilization." Feb. 1.—Professor H. N. Martin, of the Johns Hopkins University—"A Hen's Egg." Feb. 8.—Professor George L. Goodale, of Harvard College—"Seeds." Feb. 16.—Professor F. W. Putnam, Director of the Peabody Museum of American Archæology and Ethnology, at Cambridge—"The Serpent Mound and the Ancient People of the Ohio Valley." Feb. 22.—Professor Alpheus Hyatt, Curator of the Boston Society of Natural History—"A practical Example of the Evidence for Evolution." Feb. 29.—Doctor Henry P. Bowditch, Dean of the Harvard Medical School—(Subject to be announced.) March 7.—Professor Edward S. Morse, Director of the Peabody Academy of Science, Salem—"Reptilian Affinities of Mammals." The lectures will be illustrated by the stereopticon and the tickets for the course are placed at $5.00.

—In the spring ground will be broken for another section of the Museum of Comparative Zoology at Cambridge, Mass. It will be a continuation of the present west wing, and will be used to accommodate the growing needs of the botanical department. It will contain laboratories for the study of both cryptogamic and phænogamic botany. There will also be rooms for the exhibition of the collections already accumulated, for which there is no adequate accommodation. The fund for building has already been raised, through the exertions of Prof. J. M. Goodale. A collection of superb glass models, representing the principle species of flowering plants, is now being made in Germany, especially for this exhibit. When this addition is completed and the collections arranged, it will be surpassed by few in the world. The Museum has long outgrown its exclusively zoological character and has for many years contained the geological collections and some of the botanical laboratories have had accommodations in it for some time.

—Volume I, No. 1, of the *American Journal of Psychology,* G. Stanley Hall, Ph.D., editor, has appeared. It contains 206 pages, octavo, and numerous plates and cuts. 127 pages are devoted to original papers, and 79 pages to reviews and digests of recent psychological literature and to psychological notes. One of the most prominent objects of the journal will be to record the progress in

the study of hypnotism, especially in France. The first number contains the most extended and critical review yet published of the whole work of the English Society for Psychical Research. Single numbers, $1.00. Subscription to yearly volume of four numbers, $3.00. Remittances may be addressed to the *American Journal of Psychology*, Baltimore, Maryland, U. S. A.

—Prof. E. W. Claypole, of Buchtel College, Akron, Ohio, is the author of "The Lake Age in Ohio; or, some Episodes during the Retreat of the North American Ice-sheet;" with colored maps. McLachlan & Stewart, Edinburgh; Simpkin & Co., London.

—In compliance with what seems to be a wide-spread desire on the part of the geologists of America, a few have united in an effort to establish an American journal devoted to geology and its allied sciences. The new publication will be called *American Geologist*, and it will endeavor to promote American geology by fostering the interests of American geologists.

The subscription price is $3.00 per year, and the place of issue for the present is Minneapolis, Minn., where correspondence should be addressed to *The American Geologist.* From all geologists the editors solicit original contributions, and items of scientific news.

The editors and publishers, for the year beginning January 1, 1888, are as follows: Prof. S. Calvin, Iowa City, Iowa; Prof. E. W. Claypole, Akron, Ohio; Dr. Persifor Frazer, Philadelphia, Pa.; Prof. L. E. Hicks, Lincoln, Neb.; Mr. E. O. Ulrich, Newport, Ky.; Dr. A. Winchell, Ann Arbor, Mich.; Prof. N. H. Winchell, Minneapolis, Minn.

—The second number of Dr. Whitman's *Journal of Morphology* will contain the following articles: Dr. C. O. Whitman—"The Kinetic Phenomena of the Egg during Maturation and Fecundation (Oökinesis);" Dr. W. B. Scott—"The Embryology of Petromyzon;" Dr. Henry Orr—"A Contribution to the Embryology of the Lizard;" Dr. H. F. Osborn—"The Fœtal Membranes of the Marsupials;" George W. and Elizabeth G. Peckham—"Some Observations on the Mental Powers of Spiders." The number will be illustrated by ten lithographic plates.

—The Teachers' School of Science, which the Boston Society of Natural History is enabled to conduct by the aid of the Lowell Institute, will be continued this year. Professor Wm. M. Davis will give five lessons on the Physical Geography of the United States. The different parts of the country will be considered, not in the order of location, but in their natural order: (1) The mountains, as constituting the framework of the continent; (2) The plains and

plateaux flanking the mountains; (3) The rivers carrying the waste of the land into the ocean; (4) The lakes, temporarily interrupting the transportation of waste to the ocean and retarding the action of the rivers; (5) The shore-line where the land dips under the sea.

—Professor von Cienkowsky, the well-known student of the lower animals, died October 7th, 1887, in Leipzig. He was born October 13th, 1822, in Warsaw, and at various times held a professor's chair in Jaroslaw, St. Petersburg, and Odessa. At the time of his death he was a member of the faculty of Charcow.

—Recent Deaths.—Robert Francis Logan, an entomologist, at Spylaw, near Edinburg, July 28, 1887.——Pierre Millière, entomologist, aged seventy-four, at Cannes, May 29, 1887.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Academy of Natural Sciences of Philadelphia.—May 24, 1887.—Dr. Chapman presented "Notes on the Anatomy of *Echidna hystrix*.

May 31, 1887.—Dr. Leidy described *Asplanchna ebbesbornii*, a rotifer, originally described by Hudson from specimens obtained in Wiltshire, England. Dr. Leidy's specimens were from a duck-pond, sewage fed, below this city. The animal is viviparous and swarms in the pond in company with Daphnia. It has a single eye and a pair of lateral conical horns.

June 14, 1887.—Prof. H. F. Osborn presented a paper upon the "Structure and Classification of Mesozoic Mammalia, and C. H. Eigenmann "Notes on the Specific Names of Certain North American Fishes."

June 21, 1887.—Mr. Thos. Meehan stated that Chionanthus, though usually described as having perfect flowers, is on the borders of diœcism, having impotent anthers with a perfect pistil on one plant, and polliniferous anthers aud an imperfect pistil on another. This is the rule. The male plants are the more abundant. The male flowers seem only to be visited by the pollen-eating Thrips, and are therefore anemophilous.

August 9, 1887.—A letter from Miss A. Fielde, Swatow, China, describing an aquatic larva and its case, was read. The animal is stated to be near Hydropsyche.

August 16, 1887.—Prof. J. A. Ryder presented a paper upon the "Homologies and Early History of the Limbs of Vertebrates."

American Society of Naturalists.—The annual meeting (1887) was held at New Haven, Conn., in the Lecture-Room of the

Peabody Museum, on December 27th, 28th and 29th. The following papers were read:—

Tuesday—Biology.—(1) The President's address on "The Inconstant in Biology," by Professor Harrison Allen, M. D.; (2) "Perfected Wools for Detection of Color," by Charles A. Oliver, M. D.; (3) "Injection of the Thoracic Duct," by Professor S. H. Gage; (4) Exhibition of newly-devised Physiological Apparatus, by Professor H. Newell Martin; (5) "Method of Life-size Model-making of the Larger Animals," by Mr. James H. Emerton; (6) "A Lecture-room Illustration of Variation under Domestication and in Nature," by Samuel F. Clarke; (7) "Methods of Cutting Serial Brain and Spinal Cord Sections," by Professor Henry F. Osborn; (8) "A New Automatic Microtome," by Dr. Charles S. Minot; (9) "On the Preparation of Serial Sections," by Dr. Charles S. Minot.

Wednesday—"Science-Teaching in the Schools."—Papers were read by Professor Alexander Winchell, of Ann Arbor; Professor George Macloskie, of Princeton; Professor William North Rice, of Wesleyan; Professor Ramsay Wright, of Toronto.

Thursday—Geology.—(1) "The Volcano of Kilauea," by Professor James D. Dana; (2) A Palæontological paper, by Professor William B. Scott (not read); (3) "A Simple Method of Measuring the Thickness of Inclined Strata," by Mr. C. D. Walcott; (4) "Improved Machinery and Appliances for Cutting Sections of Rocks and Fossils in Any Desired Planes," by Professor William B. Dwight; (5) "The Educational Value of Micropetrography," by Professor George H. Williams; (6) "Instruction in Mineralogy and Structural Geology in the Massachusetts Institute of Technology," by Professor W. O. Crosby; (7) "Museum-Cases in Europe," by Professor Edward S. Morse.

A resolution appropriating sixty dollars for the purchase of ten copies of Volume I. of the *American Journal of. Morphology* was adopted.

Also, a resolution identical with that which passed the American Philosophical Society and six other scientific societies, requesting Congress to remove the duty on scientific books and apparatus.

The Society adjourned, to meet at the same time in 1888 at the Johns Hopkins University, in Baltimore, Md.

President, HARRISON ALLEN; Vice Presidents, G. L. GOODALE, H. S. WILLIAMS, H. F. OSBORN; Secretary, S. F. CLARKE; Treasurer, W. T. SEDGWICK; Executive Committee from Society at large, RICHARD RATHBUN and GEORGE H. WILLIAMS.

BIOLOGICAL SOCIETY OF WASHINGTON.—October 22, 1887.—Communications: L. O. Howard, An Ant-decapitating Parasite; Geo. Vasey, Notes on Western Grasses; F. A. Lucas, The Bird Rocks in 1887; A. A. Crozier, Some Botanical Terms; C. Hart Merriam, The Fauna of the Great Smoky Mountains.

November 5.—Communications: J. B. Smith, Some Geographical Variations of Insects; T. H. Bean, The young Forms of Some of our Food-fishes, with illustrations; N. P. Scudder, The Period of Gestation in the Common Mouse; H. E. Van Deman, The *Diospyros kaki* in North America; T. N. Gill, Characteristics of the Notalian Fish Faunas.

November 19.—Communications: Marshall McDonald, Explanation of Past Failures in the Culture of the Salmonidæ; Walter B. Barrows, Freshet Notes on the Rio Uruguay; T. H. Bean, Description of a new species of *Thyrsites* from the New England Fishing Banks; T. W. True, Recent Works upon Whales; F. A. Lucas, An Alcine Cemetery.

December 3, 1887.—The following communications were read: Mr. Charles Hallock, The Great Roseau Swamp; Dr. C. A. White, On the Rapid Disappearance of the Cast Antlers of the *Cervidæ;* Dr. Theobald Smith, Peptonizing Ferments Among Bacteria; Mr. C. D. Walcott, A Fossil *Lingula* Preserving the Cast of the Peduncle; Dr. Theo. Gill, The Phylogeny of the Cetacea.

December 17, 1887.—The following communications were read: Mr. C. L. Hopkins, Notes Relative to the Sense of Smell in Buzzards; Dr. Cooper Curtice, The Timber Line of Pike's Peak; Mr. Chas. D. Walcott, Exhibition of, and Remarks, on a Section of a Fossil *Endoceras*, over Eight Feet in Length; Dr. Leonhard Stejneger. On the Extinction of the Great Northern Sea Cow; Dr. C. Hart Merriam, Description of a New Mouse from the Great Plains.

Boston Society of Natural History, December 7th, 1887.—Professor N. S. Shaler read a paper on the origin of the divisions between the layers of stratified rocks. Professor G. F. Wright spoke of the glaciation of the Pacific Coast. Professor G. L. Goodale exhibited some new glass models recently obtained by Harvard University which illustrate the structure and morphology of plants.

The American Committee of the International Congress of Geologists.—This Committee met in New Haven, after the adjournment of the Society of Naturalists, on December 29th and 30th. Present—Dr. T. Sterry Hunt, Chairman; Dr. P. Frazier, Secretary, and Messrs. Cook, Cope, Dana, Hitchcock, Newberry, Powell, Stevenson, Winchell and Williams. The reports of the reporters of the different sub-committees were read and were ordered to be printed in galley form for further emendation, where thought necessary. All the reports were ordered to be completed by April 1st, 1888. A resolution inviting the Congress to meet in the United States in 1891 was adopted. The proposition to enlarge the Committee by the addition to it of additional members of the United States Geological Survey was not agreed to

INDIANA ACADEMY OF SCIENCE.—The third annual meeting of the Indiana Academy of Science was held at the Court House, Indianapolis, December 28 and 29, 1887, with Dr. John M. Coulter in the chair. The following papers were read:—"The East-West Diameter of the Silurian Island about Cincinnati," by Professor D. W. Dennis: Professor Dennis alluded to the fact that at Richmond, Indiana, there was a thin bed of rock composed of broken shells of lower diluvium age, in its character much like coquina and indicating an ancient shore line. Two similar deposits have been found in Adams and Highland counties, Ohio, and these give the means of measuring the east to west diameter of the Silurian island which existed when this rock was formed. In "Erosion in Indiana," J. T. Scovell maintained that at least seven hundred feet of erosion had taken place over the whole state of Indiana. He alluded to the ancient river channels corresponding in general to the present courses but wider and deeper, and stated that, of the drift material in the state, on the average five feet came from the state and fifty was of extra-state origin. A "Geological Section of Johnson County, Indiana," by D. A. Owen, was an account of the strata passed through in boring various wells. D. W. Dennis stated that the "Transition of *Orthis occidentalis* unto *Orthis sinuatu*" was accomplished in 300 feet at Richmond, Indiana, illustrating his point by numerous specimens. "Notes on Some Fossil Bones found in Indiana," by O. P. Hay, was the announcement of the identification of the genus Tapirus in some bones found in a sink-hole in Monroe county.

In zoology the papers were more numerous, but many of them consisted of the records of additions to the fauna of the state. Such was B. W. Evermann's "Fishes of Carroll County," in which five species new to the state were enumerated, the most noticeable being *Notropis arga* Cope, "Notes on Some Southern Indiana Fishes," by O. P. Jenkins, and "Some rare Indiana Birds," by Amos W. Butler, were of a character expressed by their titles. B. W. Evermann noticed "the Occurrence of the Star-nosed Mole in Indiana; A. W. Butler, in his "Notes on Indiana Reptiles and Amphibians," added *Plethodon cinereus, Hyla squirilla*, and two new species of Entænia to be described by Professor Cope to the fauna of the state. The "Additions to the List of Indiana Reptiles," by O. P. Hay, were *Cinosternum pennsylvanicum Tropidonotus rigidus*, and *Cnemidophorus sexlineatus* all on the authority of Robert Ridgway.

In 1869 Dr. Günther enumerated 193 species of fish occurring on one side or the other of the Isthmus of Panama, of which about one-third were regarded as common to both the Alantic and Pacific sides. D. S. Jordan, in his paper, "The Isthmus of Panama as a Barrier to Marine Fauna," stated that now there were known 1370 species from the same region of which but five per cent. were common to the Caribbean and the Pacific shores. With these data the recent connection of the two seas is not so probable as Dr. Günther's

fish figures would make it. In a paper on "Blind Fishes and National Selection," D. S. Jordan replied to the statement in some religious paper that "evolution would find it exceedingly difficult to account for these forms." In "The Origin of Genera," the same gentleman gave an outline of the view of Professor Cope on this subject and mentioned some of the difficulties which were presented by fishes, at the same time indicating the great aid which systematic zoology had received from the same theory.

"The Origin of Arthropods," by J. S. Kingsley, was a résumé of recent views on the origin and lines of descent of the various groups of arthropods. O. P. Hay, in his "Observations on Amphiama," gave some interesting facts regarding this batrachian. In Arkansas he found an Amphiama incubating her eggs underneath a log. She was coiled around her eggs and was very sluggish at first. Later she was quite cross and irritable, uttering a shrill sound like a whistle. The eggs, of which there are about a hundred and fifty, form long stings, the gelatinous envelope shrinking between the eggs so that the whole sting resembles a sting of beads. The young which were in an advanced stage of development were about one and three fourths inches in length with well-developed gills, each bronchia consisting of a main stalk with three feathered branches. The eggs themselves were about the size of a pea.

C. W. Hargitt had two papers: "Curiosities of egg formation," and "Notes on *Scaphiopus holbrookii*." The first detailed some cases of teratology in the eggs of hens and turkeys; the second an appearance of the spade-foot toad at Marthas Vineyard during a heavy rain during the past summer. A. W. Butler made some "Suggestions concerning a law for the Protection of Birds," stating that the present law would not stand, and that it is impossible to secure convictions under it. A committee was appointed to urge the passage of a suitable law embodying the provisions of the New York and Massachusetts statutes upon the next legislature. Maurice Thompson's "Secondary functions of the Hyoid corma in Picus and Colaptes" showed a lack of morphological and physiological knowledge.

The address of the president, John M. Coulter, was delivered Wednesday evening, and with "Evolution in the Vegetable Kingdom," tracing the origin of the sexual element in plants, and the gradual increase of the asexual over the sexual generations. Besides this there were six papers read on botanical subjects. Miss Lillie J. Martin spoke of the "Value of Organized Work in Plant Chemistry;" J. N. Rose mentioned the "Characters in Umbelliferæ," which he found of most value in the classification of this group of plants while working them up in connection with Professor Coulter for the Synoptical Flora. The most valuable characters were found in the fruit. Stanley Coulter spoke of the "Histology of the leaf of *Taxodium distidium*." He found the cell walls difficult to study on account of their thinness and the large cell

spaces. He described the strengthening cell system and the resin-ducts. The fibro vascular bundle in the centre of the leaf showed traces of its formation by the coalescence from two primitive bundles; whether these remained distinct at the tip the author could not say. There are eight stomata in each leaf, six above and two below.

John M. Coulter described the peculiar structure of the "Stornata of *Tillandia usneoides.*" The scales which give the Spanish moss its pubiscent appearance are to be regarded as leaves since each bears a stoma. Surrounding each stoma is a trichôner structure, in the centre of which are four sensitive cells. Below these comes the true stoma with its two sensitive guard cells. Experiments with the plants showed that this peculiar structure was to be explained by the epiphytic habits of Tillandia and the trichonu structure must be regarded as a reservoir of moisture. Walter H. Evans, in an account of the "Lichens of Indiana," gave an account of the habits and structure of Lichens and the methods of collecting these plants. He stated that he had already recognized seventy-six species of Lichens in the state, distributed among twenty-eight genera.

J. C. Arthur detailed his investigations on the "Life History of the Plum-leaf Fungus." He found that the summer spores cannot withstand the winter but that soon after the leaves fall to the ground there is a new formation of minute winter spores, the subsequent history of which he had not found out but which he was inclined to regard as male sex spores. No other spores were formed in winter but in spring the fungus took on a new development with the formation of ascospores which ripened in June. From these the leaves were infected and a new growth of the fungus took place.

The last paper was "Man an Evolution—Biological proofs," by T. B. Ridding. The author accepted the principle of evolution but claimed that there must be successive additions of Divine power in order to account for the existing fauna and flora and for the appearance of man.

Committees were appointed looking towards the purchase of scientific works by the State Library and to invite the American Association for the Advancement of Science to hold a meeting at Indianapolis in 1889. It was voted to hold the spring meeting of the Academy May 9, 1888, at Wyandotte Cave. The following are the officers for the coming year. President, J. P. D. John of Greencastle; Vice-Presidents, John C. Brunner, of Bloomington, T. C. Mendenhall, of Terre Haute, O. P. Hay, of Irvington; Secretary, Amos W. Butler, of Brookville; Treasurer, O. P. Jenkins, of Greencastle. It was voted that the past presidents of the Academy be added to the executive committee.

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ON METEORITES.[1]

BY DR. HANS REUSCH.

WE know that in the organic world, besides the larger animals and plants, there exist immense numbers of living beings of diminutive size, from those barely visible to the unaided eye down to those which can only be discerned in powerful microscopes, and of which many thousands live in a space no larger than a drop of water. Similar is the case with the heavenly orbs revolving in the infinite space. Besides the big luminaries, numerous swarms of very small bodies are hurrying through the space in their different varying orbits. To the smallest of these—the so-called meteorites—I here wish to call your attention. There is a circumstance which imparts them with a special interest to us; for they sometimes fall to the earth, so that we are able to lay hold of them, touch them with our hands, study them chemically and microscopically—in short, examine them by all the means available to us for a scientific investigation of their nature. The meteorites thus form a kind of connecting link between astronomy and mineralogy—sciences otherwise rather distant, but which in this instance are brought to mutually throw light upon each other.

It is probable that, on an average, several meteorites reach the earth every day, but many falls occur at night, while others drop into the sea, are lost in deserts or in places inhabited by ignorant people. In going over the falls of meteorites which have come to our knowledge, it appears that no more than four or five cases a

[1] A lecture delivered at the University of Christiania, Norway.

year, on an average, are recorded; and in but comparatively few instances the fallen stones are hunted up by people in order that they may become of use to science. The meteorites, therefore, owing to their variety, rank among the most precious treasures of the mineralogical museums. To illustrate the value generally attached to them, it may be mentioned that after it had become known that the meteorite found last year at Tysnæs, Western Norway, had been acquired by the Christiania Museum, a mineralogist was dispatched by the Riks-museum, in Stockholm, Sweden, the long way across the Scandinavian Peninsula, in the hope that he might be able to pick up some fragments.

A chief object of this paper is, therefore, to call the attention of the public to the meteorites, in order to prevent possible falls from being passed unheeded. The attention once aroused, it may also be possible to ferret out meteorites, the fall of which, in former times, has been kept a secret, owing to the superstition that, reduced to a powder, they might serve as a medicine for man and beast. In Norway, for instance, they were known as "thorelo"—*i.e.*, "lo," or wadding of Thor, or thunder—the belief being that they fell during thunderstorms. Not all the stones which have been preserved as "thorelo," however, are meteorites by any means, many of them being only common pebbles, pieces of pyrites, or some other kind of mineral.

After these preliminary remarks, I shall proceed to the special subject of this paper—the meteorites and their nature—to be treated of in three separate sections, viz.:—

(1) The phenomena accompanying the fall of meteorites; (2) Their mineralogical nature, and (3) Their position as celestial bodies.

The circumstances under which the fall of meteorites occur being rather similar in most instances, we may take, for an example, the fall of the Tysnæs meteorite. It occurred on the 20th of May, 1886, near the farm called Midt Vaage, situated on the Island of Tysnæs, south of Bergen, Norway. Between eight and nine o'clock in the evening the inhabitants in a wide circle of surrounding country were frightened by a loud report, which most of them took for a clap of thunder, the stone falling down immediately after the report. I have myself examined two grown-up persons who witnessed the meteorite coming down from the air. One was a woman working in a potato-field. She heard a loud noise, and,

looking up into the sky, observed a black mass of clouds, from which she thought she heard a cracking sound, repeated five or six times, upon which the stone fell with a whizzing and rumbling noise a little distance off. Dust arose from the spot where it struck the ground. The woman walked up to where it fell and saw a hole in the ground, but found nothing else, as the meteorite had bounded off several yards from where it first struck. The other eye-witness —a man who was a little further off—was just going home after having finished his day's work. He heard the report, and shortly after saw the stone coming down, "like a shot bird." No fiery display was noticed at the place; but people who witnessed the phenomenon from a distance of several miles (a Norwegian mile about equals seven English miles)—as, for instance, in Bergen and in Vossevangen—observed a fire-ball darting with great speed across the sky and then exploding in the direction of Tysnæs. Comparing the accounts of the direction of the fire-ball by the different observers, it appears that the meteor must have moved nearly vertically towards the earth's surface. That the fire-ball escaped the notice of those on the spot may be accounted for by its being right above their heads, as one seldom notices what occurs right over one's head. Their attention was first attracted by the report; but as this, of course, was heard a considerable time after the explosion of the fire-ball, the fiery display had ceased long before the thundering noise could reach them, after which some time again elapsed before the stone fell. The man pointed out to me the corner of the field where he was standing at the time he heard the report; when the stone fell he had nearly reached his house. In ascertaining the distance, he found that it took him about one minute and ten seconds to walk from one place to the other. Judging from the space of time which elapsed between the report and the fall, the explosion must have taken place at a very great height above the surface of the earth. With due regard to the traveling speed of the sound and the probable celerity of the fall, the height may be estimated at twenty to thirty thousand metres; but any certainty cannot be arrived at.

The next morning a girl living close by found a big, black stone lying in the grass. She put it aside, but did not mind it any further; and people's attention was not called to it before it was rumored that a stone had been seen falling from heaven. The following Sunday the curious stone formed the main topic of

conversation among the people assembled at church. An emigrant Norwegian, on a visit home from America and about to return to this country, made a bargain with the poor woman on whose land the stone was found: he was to take it away for a mere song; and the Tysnæs meteorite came thus very near going to America. On coming home, however, the woman became uneasy at the idea of selling such a God-send—direct from heaven—and she returned the money. Shortly after, the district physician, Mr. Gjestland, heard of the stone, and, realizing its great scientific value, he at once took it into his charge. It is owing to this gentleman's most obliging intervention that the stone—against a handsome remuneration, of course—was secured for the University of Christiania. This meteorite weighs about forty pounds. Several smaller fragments were also found.

The phenomena mentioned above—viz.: a fire-ball rushing along and exploding with a thunder-like report, followed by the coming down of the fragments—are those regularly observed accompanying the fall of meteorites. In some cases the velocity of the fire-ball has been ascertained to be sixty to seventy kilometres a second. This tremendous velocity accounts for the fire phenomenon, as the atmosphere, not being able to escape before the missile, becomes condensed to an enormous degree—a great quantity of heat thus being developed, according to the known physical laws. The meteorites, at one time having the temperature of space through which they were rushing—a temperature far below the freezing point—will thus become enormously heated on the outside when entering the earth's atmosphere. The pressure of the strongly-condensed atmosphere, finally exceeding a certain limit, acts as a blasting-agency, according to a commonly-accepted opinion, and the fire-ball explodes. The fragments are still glowing for a while after the explosion, but, as a rule, they have probably become cooled off when reaching the ground. Nor is the final speed very considerable, the original velocity of the fire-ball having been diminished by the resistance of the air.

When falling at full speed, the surface of the meteorites may be supposed to be continually melting—nay, perhaps, evaporating. By the friction of the air, however, the molten substance is removed almost as fast as it is formed. In this way the "fire-tail"—which the observers in many cases affirm having seen—may be explained. In the same manner the "smoke" is formed which, on several occa-

sions, has been observed floating in the wake of the fire-ball, after the latter has disappeared. Several people assert that such a smoke was also seen accompanying the Tysnæs meteorite. The fallen

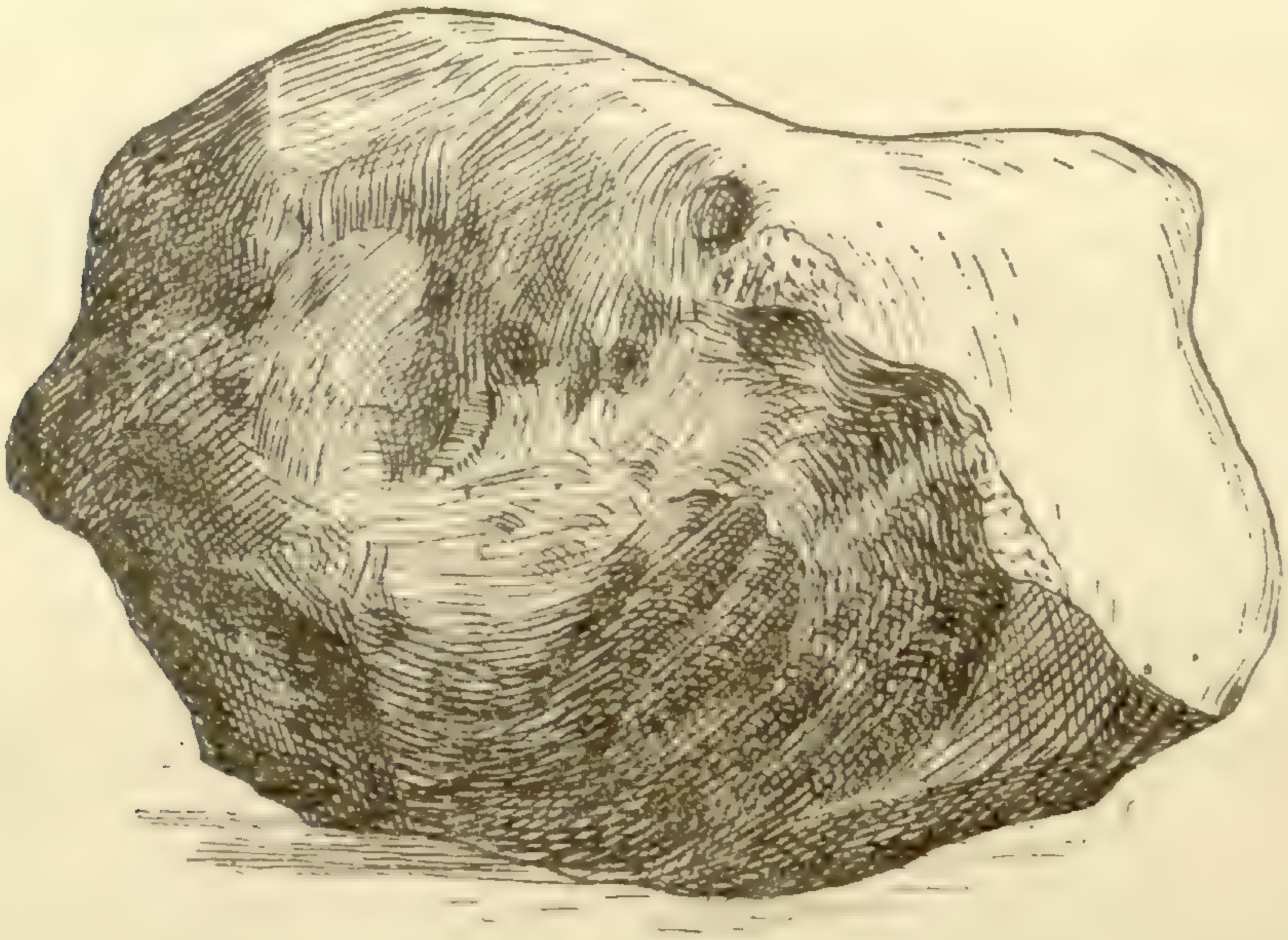


FIG. 1. The Tysnæs Meteorite.

stones show various signs of intense heating in the atmosphere, to which we want to direct the attention. In some cases, when stones have been taken up shortly after striking the ground, they have still been warm. In one instance it has been related that the fallen stone was at first so hot as to burn the fingers, and afterwards turned so cold that it could not be held in the hand for that reason. This may be regarded as very probable, when we consider that the heating in the atmosphere only lasts a few seconds, and that its action, consequently, must be quite superficial. Space, on the other hand, has an exceedingly low temperature, and the freezing coldness of the interior of the stone will therefore soon lower the temperature of the surface.

The interior of the meteoric stones, as a rule, is gray or whitish; the exterior, on the contrary, is covered with a blackish crust, which, on examination, proves to be the stony substance, having undergone a melting process. It is difficult to tell what shape the meteorites have before entering our atmosphere, as we only gather bits and fragments after the explosion. These show the effect of the compressed and intensely-heated air. The edges of the fragments, originally sharp, have become rounded, and on the surface there appear deepened marks, many of which look as if the stone had

once been soft as a dough in which the kneading-fingers had left their impressions. The air has had a consuming effect on the stone —much in the same way as a powerful jet of sand acts on a solid body. Mr. Daubrée has experimentally imitated this remarkable effect of the air. Not being able to move a solid against an aëriform body with sufficient speed—as is the case with the meteorites —he chose to proceed in the opposite way, making air strike solid bodies with great vehemence by exploding dynamite cartridges against an iron rail. The result of the experiment showed that the gases, suddenly developed by the dynamite exploding, produced hollows even in a body of such resisting-power as an iron rail, and the form of the impressions—in this as well as in his other experiments—corresponds exactly to those found in the meteorites.

Having now considered the phenomena accompanying the fall of meteorites, we shall now direct our attention to their *mineralogical nature.*

The meteorites may be classed in two primary groups: stone-meteorites—to which belongs the Tysnæs meteorite—and iron-meteorites, which consist chiefly of this metal. The two principal minerals composing the stone-meteorites are *eustatite* and *olivine* (or *chrysolite*)—both of which are also found on our globe, though rather rare—besides which these meteorites also contain grains of native iron, as an occasional sprinkling, through the mass. Examined by the microscope, they exhibit a structure which proves that originally and before entering the atmosphere they were formed out of melted masses by congelation. Fouqué and Michel Lévy have produced, artificially, the structures mentioned by melting together suitable substances. It thus appears that these small heavenly bodies, in precisely the same manner as the crust of our own globe, consist of originally molten masses, having afterwards become solidified. In this connection, it may not be out of place to remind one of the fact that the interior of the earth consists of substances heavier than those most commonly found on the surface. The meteorite is also heavier than common stone; and it has been conjectured (with several reasons to support this hypothesis) that the interior of the earth consists of a substance similar to that composing the meteorites.

On further examining the meteorites, it is found that after having passed through the original congealing process they have undergone several changes on their way through space. In many cases it is

evident that their substance has been broken into small pieces, which again have become cemented together—a structure seen with uncommon distinctness in the Tysnæs meteorite, as represented in the accompanying cut (Fig. 2). Not all the fragments are so large as to be seen by the unaided eye; for in examining the stone by the microscope some very small ones are also found, mostly of a round or globular form. This breaking up and putting together again seems in the case of the Tysnæs meteorite to have occurred at least twice.

Fig. 2. Braccious structure of the Tysnæs meteorite. Drawn by the author.

The large fragments seen in Fig. 2 are composed of smaller ones, it being a case similar to a conglomerate in which the individual roll-stones consist of conglomerate. Fig. 3 shows a portion of the Tysnæs meteorite viewed in the microscope; while Fig. 4 represents an isolated globule of olivine, greatly magnified. It contains a brownish and glassy substance, in form reminding one of the cells of plants. Similar formations, not rare in meteorites, have furnished a fanciful scientist an excuse for obstinately asserting that they actually are the remains of plants. It is to be regretted that such is not the case; for it would undoubtedly have been interesting if in this way we had been able to lay hand on specimens of organic life from other globes.

The second group of meteorites consist of native iron—as mentioned above—with an occasional sprinkling of grains of stony minerals. Native iron occurs but rarely on this globe, as iron readily enters into combination with oxygen—in other words, it oxidizes, or rusts. In fact, it is so rare in nature, except in the meteorites, that any lump of iron produced by man was formerly believed to have fallen down from heaven. This was also Nordenskiöld's impression when, some years ago, he found quite a quantity of native iron in Greenland. The find was at that time much talked of; but Steenstrup afterwards pointed out that the supposed meteorites were only big lumps of iron which had weathered out of the rock on which they were found. This rock abounded to a remarkable degree in iron.

The iron of the meteorites, as a rule, contains more or less nickel irregularly distributed through the mass. If the polished surface of the meteoric iron be exposed to the action of some acid, there will appear peculiar linear designs, called the "Wiedmannstätten figures" (after the discoverer), the acid attacking the iron containing nickel to a less degree than the pure metal.

FIG. 3. Portion of the Tysnæs meteorite, magnified 65 times. Globules composed of enstatite crystals; the cementing substance in the upper globule is a brownish glass. o, grain of olivine Drawn by the author.

We will now direct our attention to our third subject, and consider the meteorites as celestial bodies.

Before entering into this, it will be necessary, however, to say a few words in regard to *shooting-stars* and *comets,* these being the celestial phenomena with which the meteorites are most nearly comparable.

To a common observer, who does not make a special study of the heavenly vault, it looks as if the shooting-stars move quite irregularly—now in this direction, now in another. If, however, their courses be carefully traced on an astronomical chart, it will be found that in most cases they radiate from certain points in the sky —a great many of which have already been ascertained. That the shooting-stars come from a certain point means that they are moving from that section of space towards the earth, the radiation being only the effect of the perspective as they move from the distance in the direction of the observer. The best-known swarm of shooting-stars is undoubtedly the one which appears to radiate from the constellation of the Lion, and is passed by the earth on the 13th of November. As on this day extremely numerous falls of stars have been observed, with a regular interval of thirty-three years, it is

evident that they belong to a swarm which, after a revolution of thirty-three years around the sun, returns to the orbit of our globe.

The comets are apparently something entirely different from the shooting-stars; for while the latter are quite small and only appear within the terrestrial atmosphere, the comets are bodies of immensely greater size, comparatively speaking, and moving at a very great distance from our little planet. Investigation shows, however, that the orbits of both comets and shooting-stars have the same form, they being elongated conic sections: hence their approaching from distant dark regions of space—now close to the sun, now again retiring to an immense distance from it. In regard to one comet, it has, furthermore, been ascertained that it moves in the same orbit as the swarm of shooting-stars mentioned above. The exact nature of the comets has not yet been made out with any certainty, the best-supported hypothesis being that they consist of immense quantities of small solid bodies. The comets nearest to the sun, when in their greatest proximity to that body, are exposed to an enormous heat, soon followed, as they retire, by a cooling off equally enormous. The strong influence of the sun's vicinity on the comets shows itself, among other things, in the well-known long tail, which they project on the further side from the sun, and the nature and origin of which is still rather mysterious. Neither is the true nature of the shooting-stars fully ascertained. Many of them, however, appear to be small solid bodies rushing through the air; and there are a great many intermediate forms between the common shooting-stars and the big fire-balls which explode with a thunder-like report and emit meteoric stones.[1]

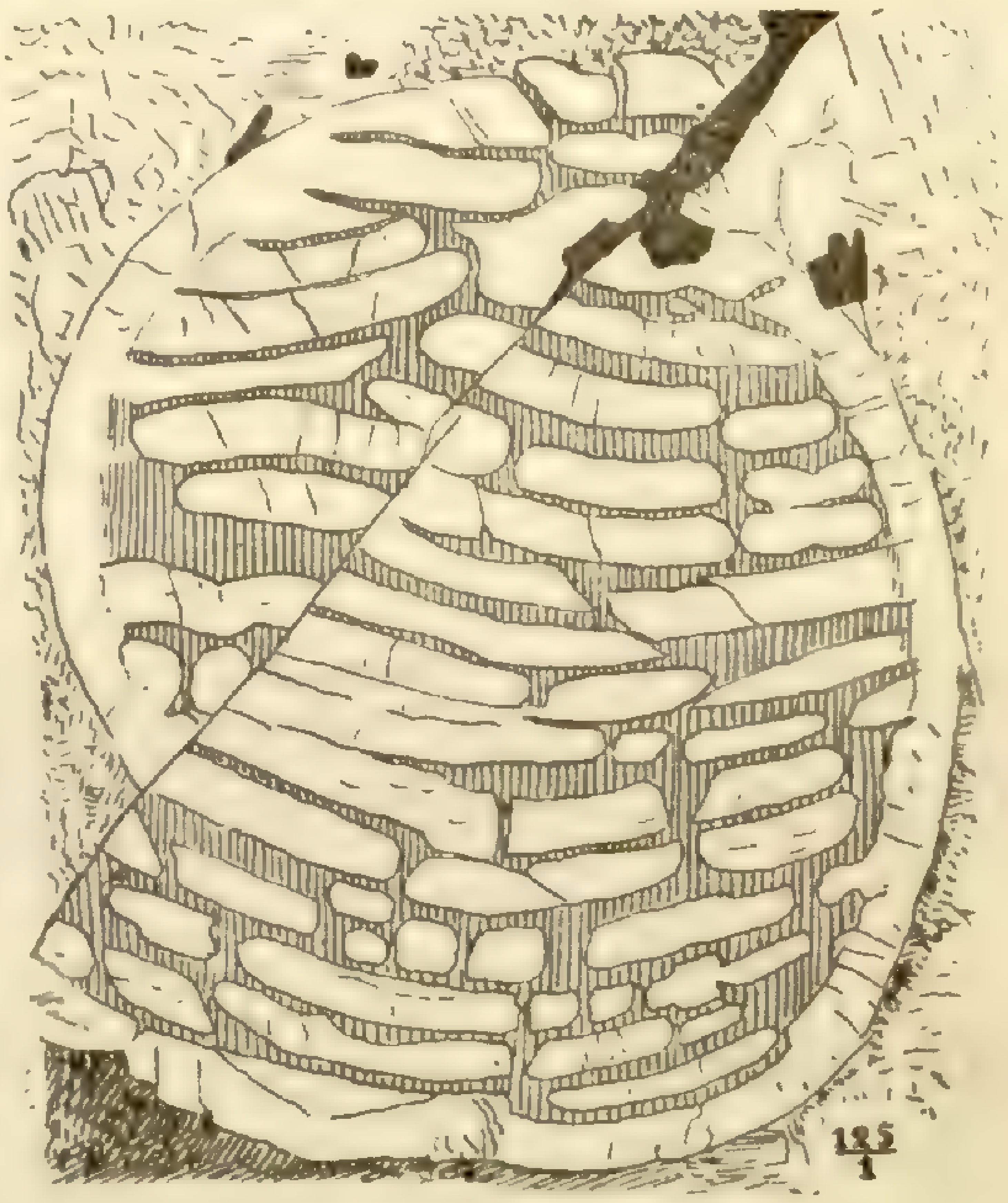


FIG. 4. Globule of olivine, divided by a fault. Magnified 125 times. Drawn by the author.

[1] Mr. Sophus Tromholt, the author of the beautiful work, *Under the Rays of Aurora Borealis*, has sent me the following interesting record of a shooting-star:—

"One starlight but moonless Saturday night during November or

In the meteorites we have, as seen, at last something palpable which we are able to study. It will therefore be of great interest to have their connection with the shooting-stars and comets more definitely established. The study of the orbits of the meteorites, however, is rendered much more difficult than that of the shooting-stars by their comparatively much rarer and more unexpected occurrence, by the terrifying phenomena often accompanying them, and by the fact that they are seldom observed by others than ignorant people. The mode of studying the orbits of the meteorites must, therefore, be different from that suited to the case of the shooting-stars.

Having made a special study of the dates of the recorded falls of meteorites, I have come to the conclusion that they, or at least some of them, may be referred to certain systems like the shooting-stars, and that in some cases periods—suggesting a connection with a certain group of comets—may be set down with some probability.

The orbit of the earth around the sun may be considered as divided into three hundred and sixty-five parts, one of which is traversed on each day of the year. That the fall of a meteorite occurs on a certain date means, then, that the part of the earth's

December, 1883, between eight and nine o'clock, as Mr. Lionæs, a bookseller in Fredrikstad, Norway, was standing in his yard looking incidentally up into the sky, he observed a shooting-star in the north, at a height of about 60°, moving in a curve and gradually increasing a little in size. The exact length of time he is unable to state: he had turned his eyes away, when suddenly a small, shining body fell down before his feet, not two yards off, passing him so closely that in his fright he sprang aside. When the meteor struck the ground sparks flew in all directions, and a faint report was heard. This noise was also heard by his daughter, who at the time was in the passage leading to the yard. Shortly after—'about a minute'—both father and daughter observed a similar meteor in the same direction, which seemed to descend behind a neighboring house.

"The gentleman mentioned is uncertain as to the exact date of the observation; but the choice seems to lie between the Saturdays, November 3d, November 23d, and December 1st; but as, according to the meteorological observations recorded at the Fredrikstad Station, the sky was overcast on the two former Saturdays, the fall must have taken place on December 1st, when the weather was rather clear. He has stated to me that the size of the shining body was comparable to that of a walnut, and the little fragments into which it was broken when striking the ground he compared to small beads. Unfortunately, he omitted to collect them, and later search was unavailing, as the yard had been swept several times afterwards."

orbit designated by this date is intersected by the orbit of the meteorite. It now often happens that the earth is struck by meteorites on the same date during two or several consecutive years. This can only be explained by the earth on that date passing through a swarm of meteorites, or, rather, through a long stream taking several years in passing—if we consider that, on an average, no more than four falls of meteorites are recorded yearly. Thus, the earth was hit four times by meteorites on the 13th of December, between the years 1795 and 1813.[1] Since then the earth has not collided with any meteorites on that date.

Still more remarkable than dates which, like the above, show the meteorites to go in flocks, are others from which, with a considerable degree of probability, we may infer a certain period. Thus, the 13th of October is a date worth mentioning, as on that day falls of meteorites occurred in 1787, 1819, 1838, 1852 and 1872. On examining the differences between these years, they will be found to be very nearly multiples of $6\frac{1}{2}$—viz.: 5x$6\frac{1}{2}$, 3x$6\frac{1}{2}$ and 2x$6\frac{1}{2}$. These falls, consequently, seem to belong to the same flock, with a period of between six and seven years. The flock must be rather lengthened and takes a considerable time to pass, since the earth passes it so often, as is recorded in this case. If the stream be short, there is, of course, very little change of the earth being just in the point in which the orbits of the earth and the meteorites cross each other every time the stream is passing. This would only be the case if the period were exactly one or more whole years. As this, of course, occurs but very seldom, it is not to be expected that the differences between the years be exactly multiples of the periods.

It may be well to quote other similar periods of meteorites. In February, two series of falls are particularly notable, viz.:—

February 19, 1785, at Witmess.	February 19, 1796, at Tasquinha.
" 18, 1815, at Duralla.	" 18, 1824, at Irkutsk.
" 16, 1876, at Indesgherry.	" 16, 1883, at Alfianella.

The possibility here suggests itself that the earth on February 19, 1785, met a flock of meteorites which, with a period of about thirty years, reappeared in 1815. No fall is on record from the next meeting. From the one then to follow, however—that is, from the one to take place sixty-one years from 1815—viz., in 1876, a fall is recorded. It will be observed that the dates are receding,

[1] To these falls may be added a fifth, which occurred on the Western Hemisphere, December 14, 1807.

as the first fell on the 19th; the second, on the 18th. The third fall, if it took place, probably occurred on the 17th; while the fourth happened on the 16th. This regular receding of the dates may be explained without difficulty as due to the precession retrograding comparatively fast. The case of the three falls of the second column may be the same, though their period must be shorter, the difference between 1796 and 1824 being 28, and that between 1824 and 1883 being 59.

We give below a list of other systems, in regard to which we remark that the figures in parentheses indicate the differences between the contiguous years:—

Period—Between six and seven years.	May 9	Drake Creek	1827	
	" 8	Monte Milone	1846	(19)
	" 8	Dyalpur	1872	(26)
	" 10	Estherville	1879	(7)

Period—Between six and seven years.	May 11	Oesel	1855	
	" 12	Bremewoerde		
	" 13	Butsura	1861	(6)
	" 14	Canelles		
	" 12	Kursk	1874	(13)
	" 14	Nash County		

This latter system is perhaps a double one, as in the same year two falls occur at an interval of a day.

Period—Between six and seven years.	March 15	St. Étienne de Lolm and Valence	1806	
	" 14	Cutro	1813	(7)
	" 15	Lugano	1826	(13)
	" 16	Rutlam	1863	(37)
	" 14	Middlesborough	1881	(18)

Period—About six years.	August 10	Slobodka	1818	
	" 10	Iwan	1841	(23)
	" 11	Bentham	1859	(18)
	" 12	Dundrum	1865	(6)

Period—About seven years.	July 3	Mixburg	1725	
	" 3	Plan	1753	(28)
	" 4	East Norton	1803	(50)
	" 4	Crawford	1859	(56)

Period—Eight years.	June 26	Dogowola	1864	
	" 28	Tennasilm	1872	(8)
	" 30	Nogoya	1880	(8)

Period—Eight years.	September 5—Agen	1814		
	" 5—Fehrbellin	1854	(40)	
	" 5—Dandapur	1878	(24)	

Period—Nine years.	September 10—Limerick	1813	
	" 10—Carlstadt	1822	(9)
	" 9—Wessely	1831	(9)

In November there are several falls, suggesting periods of ten years, viz.:—

November 5—Bourbon, Vendée	1841	
" 5—Nulles	1851	(10)
November 11—Lowell	1846	
" 12—Trenzano	1856	(10)
November 29—Cocenza	1820	
" 30—Shalka	1850	(30)
November 30—Futtehpore	1822	
" 30—Myhee Caunta	1842	(20)

ollowing series the five last observations correspond to a period of about twelve years:—

May 19—Novgorod	1421	
" 19—Schleussingen	1552	(131)
" 18—Walringen	1698	(146)
" 17—Hampshire	1806	(108)
" 17—Perth	1830	(24)
" 17—Igast	1855	(25)

The oldest date is uncertain, 131 being one less than 11x12. Suppose the period being only one-half as long as indicated above, still another date might be added—viz.: May 18, 1860, on which day a fall occurred at London.

In the following system, which has a period of about twenty-three years, the dates are receding:—

August 6—Dortrecht	1650	
" 5—Chantonnay	1812	(162)
" 4—Cirencester	1835	(23)
" 2—Pawlowka	1882	(47)

As a result, then, several flocks of meteorites can be pointed out, which have a certain period, the latter being, in most cases, between six and eight years. It is noteworthy, in this connection, that the

period of most of the comets, the return of which have been observed, is five or six years. The study of the dates of the different falls, therefore, not only suggests that at least a part of the meteorites move in orbits round the sun, but also intimates a certain relation of some of them with a definite group of celestial bodies—viz.: the comets of short periods. We have thus established a new link connecting the meteorites with the comets in addition to those already known—viz.: the strong resemblance of the fire-balls to the shooting-stars, as well as the great velocity of several of the former, making it probable that they move in orbits of the same lengthened form as the comets. If called upon to define the nature of a meteorite, briefly and somewhat boldly, I should say, with Mr. Newton, the American: A meteorite is a bit of a comet.

Let me add a few remarks in regard to the question whether there is anything in the structure of the meteorites which goes to confirm the views here set forth. The orbits of the meteorites being similar to those of the comets, the consequence would be, as mentioned above, that during a comparatively short time, once in each period, when near the sun, they would be exposed to an enormous heat, succeeded by quite as enormous a cooling off in the cold parts of space. The fragmentary (chondrite) structure, so general in the stony meteorites, is perhaps to be explained in this way. On the earth the annual and daily heating and cooling produces, as we all well know, the weathering or general crumbling of the earth's crust, the formation of stones, gravel, sand and dust. There is a difference in regard to the meteorites, in so far as they are not covered with water or surrounded by an atmosphere, by which agencies the weathering of our earth is brought about; but, on the other hand, the difference between the heat and the cold, owing to this very want, and especially to the form of the orbit, must be enormously greater on the meteorites; for while the differences of temperature on the earth rarely rise to 50° C., the changes which take place on the meteorites must be estimated at 1,000° C., or more. It may not, then, be unreasonably supposed that the fragmentary structure so common in the stony meteorites is due to the changes of temperature they have undergone. How the fragments may have become rounded off by being ground against each other or in some other way, may easily be conceived, as there are plenty of instances in regard to comets, in which movements in their mass have been observed. Theoretically, the study of the Tysnæs mete-

orite is interesting, not only for the fact that it clearly shows the chondrite structure to be of a fragmentary nature, but especially because it affords proof of the process having been repeated—a circumstance not at all surprising in a celestial body which, in its wanderings through space, has repeatedly approached close to the sun.

In addition to the above, it should also be remembered that the gases—carbonic acid, carbonic oxide and hydrogen—which have been successfully extracted from meteorites, are said to give the same spectroscopical lines as the comets when approaching the sun.

The above explanation of the different peculiarities in the structure of the meteorites is advanced here, of course, chiefly to instigate further investigation. As here propounded, it does away with all moments which may not be reasonably admitted in regard to the orbits of these celestial bodies, thus, for instance, making unnecessary any recourse to volcanic or other processes supposed to have taken place on distant globes once large, but long since exploded.

In support of this latter theory—viz.: that the meteorites have originally belonged to globes of considerable dimensions—it has been argued that the formation of so large crystals as are found in some iron meteorites can only have taken place on a celestial body of respectable size. The correctness of this inference may well be doubted. It is true that on our earth—which, in this connection, may be regarded a big globe—some minerals form large crystals during a slow growth; but it cannot be inferred from this fact that large crystals cannot appear on a very small one. The mere circumstance that in the latter the force of gravity is practically nil makes matters there stand quite differently from what they are on a great celestial body. It may be supposed that as the force of gravity plays only an insignificant part, those other forces which produce the arrangement of the molecules in the crystals are allowed to have their play much more freely than under other circumstances. The smallness of the meteoric masses may perhaps also account for their easy crumbling and the dislocation of the fragments. The minerals of the meteorites, which on our globe appear to belong to the comparatively heavy substances, may in a certain sense be said to weigh nothing as long as they form part of a celestial body perhaps not a yard in diameter.

Among other things, it may also be supposed that the electric forces called into activity by the violent changes of temperature

play a much greater rôle than we might be apt to imagine, judging from the processes which take place on our earth.

Finally, I may mention that in some meteorites there is found evidence of their having been exposed to an enormous heat after their original formation. Several meteorites—particularly one from Stælldal, Sweden, which I have examined myself—show traces of an inner melting which must have taken place somewhere in space before entering our atmosphere, and which has nothing to do with the ignition of their surface in the latter and the molten crust

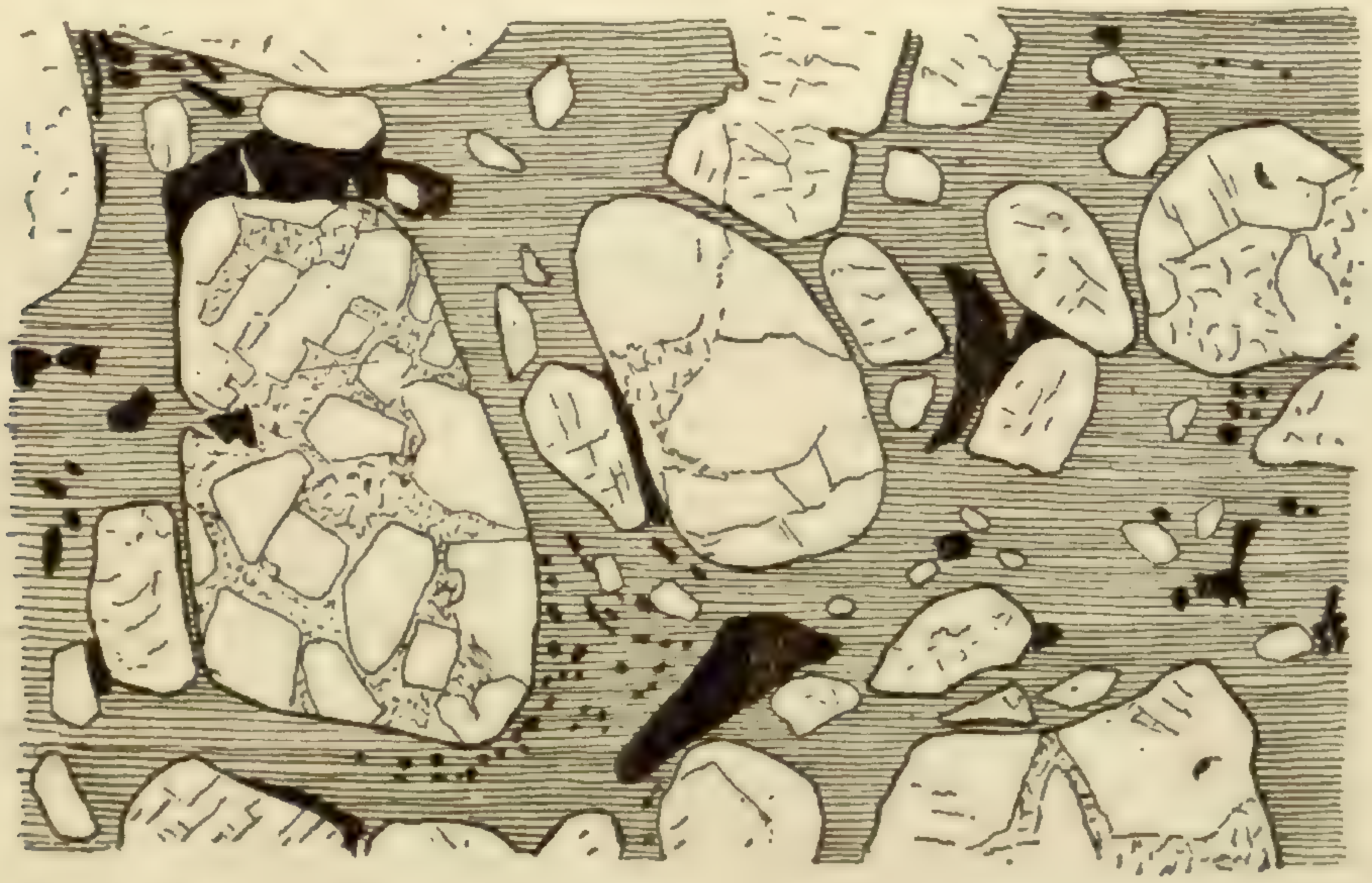


FIG. 5. The Stælldal meteorite viewed in microscope. $\frac{65}{1}$ Drawn by the author.

thus produced. The appended cut (Fig. 5) shows a portion of the Stælldal meteorite sixty-five times magnified. The black parts are iron; the light ones are pieces of unmolten substance swimming in a brownish glass, the chemical composition of which is like that of the unmolten substance. It will thus be seen that in the structure of some meteorites we have a direct proof of their orbits being of the same striking form as those of the comets, which alternately approach close to the sun and then again recede far from it.

THE GERM OF THE SOUTHERN CATTLE PLAGUE.

BY FRANK P. BILLINGS.[1]

IN order to prove that it is the manure of infected cattle which lodges the germs of Southern Cattle Plague, we must first find the germs.

Has anybody found them? To which I answer that there has, and that the honor belongs entirely to Nebraska, as well as does that of completely connecting the germ of swine plague with that disease, and discovering the true nature of that pest. Detmers saw the germ of swine plague first, but it was left to us to prove its unquestioned connection with that disease. Our discovery of the germ was as original as if it had never been discovered, but in no way detracts from Dr. Detmers' credit as the first discoverer.

Detmers found a germ in the Southern Cattle Plague, but it was a large baccillus, and had no direct connection with the disease. Salmon found another coccus in this disease, also, but it was a double coccus, and had no relation to it. These observations will be considered in detail in our full report. How may we know that we have discovered the germ in any specific disease? In order to make such an assertion the following conditions must be fulfilled in every detail:—

First.—In the tissues of animals ill with a specific disease must, in each case examined, be found the same germ.

Second.—This germ must be cultivated, free from every other germ, in some of the artificial media.

Third.—It must be shown that the germ in question has pathogenetic (disease-producing) qualities, by inoculating animals and killing them thereby.

These three conditions have been fulfilled. The germ of Southern Cattle Plague has been found in the blood, the gall, the urine, the liver, spleen and kidneys of every diseased animal on which we have made an autopsy. These germs have been also cul-

[1] Director of the Patho-Biological Laboratory of the State University of Nebraska.

tivated in an absolutely pure form upon and in artificial media. Gophers, or ground squirrels, have been inoculated with such cultivations and died from the effects, and the same germ found in their blood and tissues, and in sections made from their organs. Cultivations from the same have been also made, invariably showing the same germ as that got from the cattle.

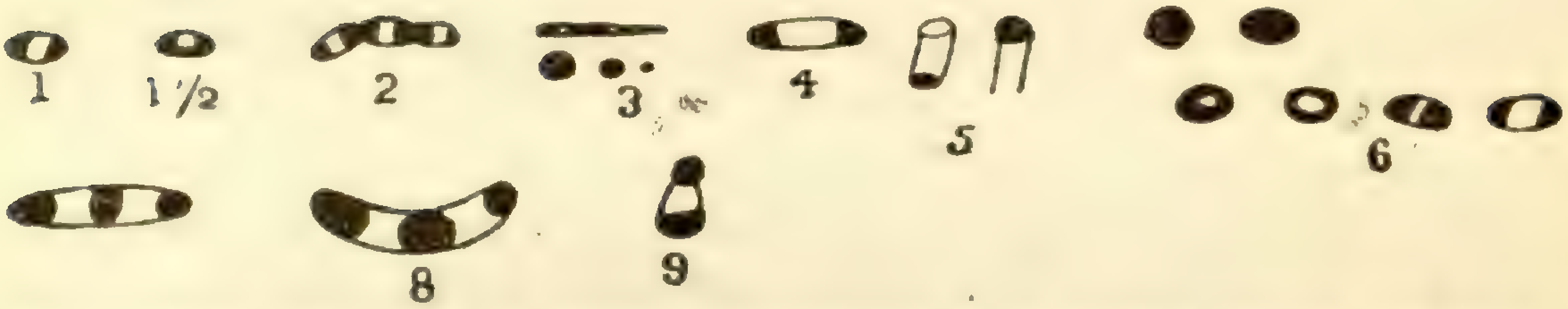
These results, however, do not show that this was the germ of Southern Cattle Plague. They only show that a germ was found in the tissues of Texas fever diseased animals that had fatal disease-producing properties.

How, then, can we tell that it is the specific germ of the Southern Cattle Plague?

To be able to affirm this fact positively cattle must be inoculated, as the ground squirrels were, with unquestionably pure cultivations, and the Southern Cattle Plague produced in those cattle, and the same germ found in their tissues and cultivated from them. We have done this, and can demonstrate the entire series of facts by cultures and microscopic specimens of the tissues.[1]

[1] Above I have stated the conditions which must be fulfilled in order to completely substantiate the discovery of a specific germ. I wish, however, to call attention to the discovery of another pathogenetic organism in which these conditions cannot at present be fulfilled and may never be so conclusively as we are enabled to do with germs of animal diseases. I allude to the germ of Yellow Fever, for which I claim not only the first discovery by an American, but for the only exact description of it. Babes saw it and partially described it, "Les Bacteries-Babes-Cornil," 1885, as follows:—

'The capillaries of the liver and kidneys contain great numbers of jointed filaments. With a Zeiss $\frac{1}{18}$ H. I., one sees these filaments to be made up of elliptoid-cylindrical granule united in pairs, or forming small clusters, in which *they are united by a pale intermediate substance.* The filaments are thus made up of diplococci or of very short segments," p. 448. In the "Comptes Rendus," Aug. 1887, p. 289, Lacerda attempts to describe an organism which he says is the same as that described by Babes, but his description is such a lamentable failure that no one would recognize the germ from it. In pieces of liver and kidneys from a case of "Undoubted Yellow Fever," sent me by Dr. Geo. M. Sternberg, I discovered the same organism described by Babes, and, no other being present, and the yellow fever a specific septicæmia, and this organism belonging to the same group, I make no hesitancy in affirming that it is the germ of the yellow fever, even though unable to fulfill all the necessary postulates of exact experimentation. On the other hand, the description of the germs of the Southern Cattle Plague and Swine Plague belonging to the same group, and an accurate knowledge of several others belonging to this species, warrants the assertion that this



Morpho-Biological Characteristics of the Germs of the Southern Cattle Plague and the American Swine Plague and their Points of Differentiation.[1]

These two micro-organisms are neither to be classed with Micrococci or Bacilli. They are not round objects like the former or rods like the latter. They belong to the intermediate group, to which the name "bacteria" has been given. Their longitudinal dimensions are about twice that of their transverse. They are ovoid. Their ends are rounded. If an endeavor be made to differentiate these germs from one another by a microscopic examination we shall find it impossible. They are approximately of the same size and shape. Fresh specimens of them both will not differ so much in dimensions as old cultures of either will from fresh ones, or different individuals in the same old cultures. They are description will answer in nearly every particular and every chief essential. The only points where a difference may be found will be these :—

1. The yellow-fever germ may cause gelatine to become fluid but probably not as no other of these germs does.
2. It may grow differently on potatoes and egg albumen.

In this regard attention will be called to the difference between the germs of the Southern Cattle Plague and Swine Plague when developed on potatoes. Now I have still another and hitherto unknown germ of this same group of which more will be heard later on.

On potatoes, the Swine-Plague germ grows a light gray-brown, coffee-colored ; the Cattle-Plague germ in yellow colonies becoming reddish, this new germ pure white.

On whites of eggs, the Swine-Plague germ grows in a semi-fluid almost pure white colony, difficult to see.

The Cattle-Plague germ develops in a delicate buff color with sharply circumscribed walls, while the new organism grows in deep yellow colonies with diffuse edges. However, I feel that aside from these points, the description herein given will answer completely for the germ of the yellow fever. Morphologically it cannot be distinguished surely from either of them.

[1] With the exception of the points to which attention has been called as to the germ of Yellow Fever.

about $\frac{1}{6}$ the transverse diameter of a red-blood cell, in length. In one way, however, they can be easily differentiated even by microscopic examination. *The swine-plague germ has a far sharper affinity (its poles) for the blue and violet tinctions than that of the Southern Cattle Plague, while the latter possesses a special affinity for Fuchsin, which the former does not.* Whatever the tinction used, if applied *lege artis,* the ends, poles, of these micro-organisms show a great specific affinity for the coloring material, *while the middle portion of their bodies has far less,* unless the exposure is pushed to a longer period, when this portion of the body will eventually color. The capsule of these germs seems to be composed of the same material as the ends, as it also colors in the same manner, thus presenting a delicate line of colored material, connecting the two colored, coccoid ends, or poles.

The most practical illustration which can be given of the microscopic appearance of these organisms, is to take a small white bean and paint both of its ends and two of its sides blue or red, leaving the middle portion unpainted. Looking down upon such a bean would give almost an exact picture of these germs.

Like the genuine and only germ of the American Swine Plague the micro-organism of the Southern Cattle Plague *is motile in fluid cultivating media when studied microscopically, as well as in the serum from the blood of diseased animals.*[1] The movements of the latter are, however, *less rapid or active* than those of the former organism.

In my earlier description of the micro-organism of the American Swine Plague, I called attention to the great morphological variations which it undergoes in its full cycle of development. These are its morpho-vegetative phenomena.

To one entirely unaccustomed to observing them, the first appearance of a cultivation of these germs—more especially an old one—would prove very puzzling. In fact, the novice would very often conclude that his cultures had become polluted by micrococci, so plentifully are these objects, apparently, represented. They simply represent a vegetative, embryonic, period in the development of this class of micro-organisms.

[1] For some, to me, unaccountable reason the German observers say the germ of the German Swine-Plague is not motile and Cornil says the same thing. *Now I positively assert the micro-organism of these two American diseases to be motile as well as a third one which I am not yet ready to describe.*

Hueppe has fallen into the serious error of endeavoring to classify these organisms by this vegetative morpho-condition. He calls them "Micrococci." To my mind it would be equally sensible and logical to call an ovum a man, or an apple seed an apple tree. It is far more practical for patho-biologists to stick to the name cocci for all round objects (not spores) which have equal diameters in their mature form and which color diffusely, and to call these ovoid organisms bacteria, where the longitudinal diameter does not more than over again exceed the transverse. As to bacilli, spirilli, etc., there need be no dispute, so plain are their morpho-characteristics.

The mature micro-organisms of the American Swine Plague and Southern Cattle Plague has been described above (Fig. 1) as resembling a white bean with the ends painted as well as its sides, leaving the middle portion of its body unpainted, as we look down upon it. Now that is the picture which the eye generally receives, but a more exact inspection of a stained covering glass specimen will show that the above is not always the appearance presented to the eye, even by the mature germ.

The above description depends upon the germ presenting itself to the eye in an exact horizontal position, that is, lying straight on its horizontal axis. If, however, it be turned a little one way or the other on its horizontal axis, numerous specimens will be seen where the white belt does not extend entirely across the object, as above described, but seems to be limited, more or less, to one side, and more of the colored substance will be seen on the opposite side than under general circumstances, or, perhaps better, in exact inspection (Fig. 1½). At first I mistook the appearance for the accumulation of the uncolored substance in this way during the process of its secretion from the colored ends, which I take to be the method by which this non-coloring material is produced. More mature reflection has shown me that the above explanation is partially or wholly incorrect. It has been mentioned that that portion of the capsule of these micro-organisms must have the same chemical composition as the pole ends, because it also colors somewhat under the same application of the tinction. Now why does it not show the same intensity of coloring? The only answer is: *that this capsule, being very thin, cannot take up as much color as the more dense pole ends; and being so thin, by the same amount of exposure, does not show any color when the middle of the object is looked directly*

down upon, but when the eye strikes the sides of the object, then we look through more material and, hence, see more color, just as when we look at a piece of window glass or a good glass slide. If we look directly through it, it is colorless, but if we turn it on edge and look at it, it has a more or less green shade, according to the quality of the glass. So according to the amount of exposure to the tinction, when not carried so far as to color the whole body of the germ, we have more or less visible coloring of the capsule, which can only be seen when we look through a considerable extent of substance, that is, on the sides of the object. Again, we may see two or three objects united together, all presenting the normal characteristics of full maturity. I have never yet seen more than three of these germs connected together (Fig. 2). In general they either appear singly or in pairs. In very old cultures these micro-organisms become thinner, more rod-like, and color more diffusely with the same degree of exposure to the tinction, and the white substance is either not visible at all or very faint (Fig. 3). Again, such old cultures are very replete in apparent micrococci, of various dimensions, which might lead one into the error of thinking that his cultures had become polluted. I call this last condition *that of coccoid degeneration* (Fig. 3). Or, we may see unusually long objects, the longitudinal diameter being twice or three times that of the mature organism, and the white, or uncolored, substance occupying a corresponding extensive amount of space, while the dark, or colored, ends may be somewhat larger or of the same size as those of the mature object. *This condition represents the first step in the development of these organisms, that is, they become longer, and more of this white substance appears* (Fig. 4).

The next step in the process of vegetative development is the separation of one of the pole or coccoid ends, which then becomes free, and for a moment is exactly round like a coccus, and, as in a hanging drop culture (to which I always add a very small amount of an aqueous coloring solution), one will naturally see a very large number of these coccoid objects on account of the fact that each individual present is continually going through the same process of multiplication. Here, again, one may see a condition or phenomenon that might be misleading.

One of the coccoid ends having been separated, the other may still remain connected with the white material, and as evidence that the colored ends have a greater degree of specific gravity, as well

as chemical composition, you will see, in the continual tumbling about, and turning over and over of their objects, *a white, round or nearly so, colorless object directly under the eye, or numbers of these objects.* When the germs in such a hanging drop culture have died from want of a sufficiency of nutrient material, you may see a large number of these objects, *which could be easily mistaken for spores:* but if we inoculate a new hanging drop culture from the same material used to prepare the former, it will be found impossible to fall into any such serious error, for it will be easily seen that these non-colored refracting points keep continually going out of sight, their place being taken by the coccoid non-refracting point still attached to the other end of the white substance, and by watching one and the same organism in its continual turning over, first one appearance and then the other will be presented to the eye until the second coccoid end has become detached (Fig. 5).[1]

What becomes of the uncolored transparent middle piece?

I do not know!

It appears, however, as if it underwent an almost immediate process of dissolution the moment it has become free from both of its polar attachments. That this substance does not represent a spore condition, or have any relation to spores, is to my mind entirely beyond all question, as I have searched most diligently for spores in old and fresh cultures, and others made at all kinds of temperatures, within the biological limits of these organisms.

In my first-published description of the micro-organism of the swine plague I gave an erroneous description of the manner in which the coccoid ends became freed from the white or connective substance. *This white, non-refracting, uncolorable material does not become extended to nothing, and then break in two, leaving the coccoid ends with a delicate, colorless flagellum, or spermatozoid tail, temporarily attached to one side,* as I then said, and as Detmers described it in 1880; *but the separation of these ends is direct, and by sharp segmentation. Were it otherwise we could not see the sporoid colorless ends of so many of these germs when freed from their appropriate pole ends.*

There are days when one cannot study them continuously at all. The best way to study hanging drop cultures, when one desires to spend several hours over them, is to first make some cover-glass

[1] Coloring such a specimen will at once show that no spores are present.

specimens of the same material, or take any other slides of an object of the same size and form, and observe such for about half an hour, thus preparing the eye to see what you want to see in the living developing organism. Unless this is done, some very essential points will be surely missed, and some preventable error fallen into. With anything less than a power of 800 diameters no one should attempt to study these organisms, and then only when aided by the best of Abbe condensers and oil immersion lenses.

We left our studies with the mature object proliferated into its first distinct stage of vegetative di erentiation. We had two coccoid objects before us, that is, two round objects, their diameters being the same in any direction. If colored, they color throughout, that is, diffusely.

Were these objects to remain in this condition, they would be, indeed, *Micrococci.* They do not, however. They almost immediately begin to increase in a longitudinal direction, but in this condition they still stain diffusely.

In my first description of the swine-plague germ, I said *that the next biological phenomenon was the appearance of a delicate white line, separating this ovoid object into two halves.* The above, while not exactly an erroneous description, is certainly anticipated by another phenomenon in the evolutional development of this coccoid, diffusely coloring object, into the mature form of any of this class of germs. *That this white non-coloring substance is a secretion of the two poles, or coccoid ends, of these "belted" germs, as well as that it has a different chemical composition, is beyond all question.*

The phenomenon above spoken of, as anticipating the formation of the segmenting white line which separates the two darker portions of these organisms is: *that this white substance first appears in the centre of the body of the dense, dark ovoid object as the minutest of white specks, which gradually increases in size and quantity, and extends across the entire object;* the white line, *being at first broader in the middle, but gradually widening until it completely and clearly separates the two pole (coccoid) ends, and the mature object is again presented to our view* (Fig. 6).

We have thus described the normal, or general, cycle of development of the micro-etiological organism of the *American, English and German Swine Plagues, the American Southern Cattle Plague, Hen Cholera, the German "Wild-Seuche"* (of deer, swine and cattle) and *Rabbit Septicœmia,* all of which diseases are caused by a

member of this class of "belted" germs, and should be classed as extra-organismal, local or land septicæmiæ. It seems to me that the germ of Yellow Fever, as well as the disease itself, should also come into this group.[1] I am sorry to say that, notwithstanding the results claimed by Freire, I am unable to find a single exact and detailed description of the germ with which he works, and which should therefore be the etiological moment in the Yellow Fever, if there is any trustworthiness in Friere's statements.

Morpho-biological Resemblances not sufficient to Pronounce Pathogenetic Germs or Diseases caused by them Identical.

This part of my work would be left incomplete did not I allude to an endeavor of Hueppe's to show that the diseases named above, aside from the Swine and Southern Cattle Plague of this country, are *identical,* that is, the German, Schweine-Seuche, Hühne-Cholera, Kaninchen Septikamie und Wild Seuchë must all be one and the same disease; *because their germs have each and all the same form, the same size, the same "belted" appearance, and because they all grow alike in bouillon, on agar agar and in gelatine.*

The Germans do not say anything as to how these germs deport themselves on potatoes. *The Schütz-Loeffle germ does grow on potatoes,* as Professor Kitt, of Munich, assures me.[2]

No greater or more misleading statement could be made, or perhaps it would be better to say principle or theory enunciated.

The most complete morphological resemblances and exact morpho-biological relationship in or on artificial media are not sufficient grounds for any such attempt at generalization as Hueppe's in the case of these diseases.

To all beginners in this work, and all older hands as well, I most emphatically assert that there is but one factor in the biology or morphology of etiological micro-organism which can decide whether two germs apparently alike are one and the same object, when derived from two distinct diseases of animal life.

That factor is a physio-chemico-biological one. Both germs must produce the same disease in both species of animals: the same chemical and pathological phenomena which occur in the same diseases and

[1] Confirmed as herein stated by researches subsequent to the preparation of this paper.

[2] Colin says the same.

in the same species of animals under natural conditions, when healthy animals of the given species are inoculated with artificial cultivations of the germs in question. Our experiences here completely upset Hueppe's hypothesis.

The American Swine and Southern Cattle Plague should, accord ing to Hueppe, be identical diseases with those mentioned as considered so by him in Germany, because, according to his condition, *the germs are identical.* Hueppe's entire argument is completely nullified by the following facts:—

First.—*There is no Southern Cattle Plague known in Europe.*

Second.—*Cattle and Swine run together in this country, and one or the other may have respectively Swine or Cattle Plague, and yet the other species will never become ill, even from the closest contact with members of the other species sick with its peculiar plague.* Hens can feed on hogs dead from the swine plague, from the ground polluted with their discharges, even picking out grain from the same, and still remain well; and the same is true of the hogs with regard to Hen Cholera and the Southern Cattle Plague.

Hence, no matter how these germs may resemble each other, when artificially examined, they fail in the one great factor necessary to make the diseases produced by them identical; they do not have the same physiological chemical attribute with regard to a given something produced, which invariably decides the pathogenetic results produced by a given germ. Notwithstanding the latter fact, these diseases all have a very close relation to one another. *They are all extra organismal, local land septicæmiæ.* Each one, however, has something peculiar about them that prevents them from being identical diseases, aside from any action of the germ.

Each species of animal in which they occur has some unknown constitutional idiosyncrasy which renders its members susceptible to the action of a given germ, and each of these germs has some peculiar unknown biological idiosyncrasy by which alone it infects, naturally, but a given species of animal life.

These two factors, together, can alone decide the identical question. What we can do artificially, by the inoculation of those animals that the disease does not occur in naturally, has no necessary relation to the question whatever.

There are, however, other phases in the development of these germs of a bio-morphological character. For instance, as already said, we may see two or three individuals of the mature type united

together (Fig. 2), or we may find two apparently mature organisms enclosed in a common capsule, the two medial dark points or poles being in such close apposition that no line of demarcation or indentation of the capsule can be seen at this point, the whole outer surface being smooth (Fig. 7). On the other hand, the two lateral ends, or free poles, are separated by the normal quantity of white, non-colorable substance.

Again, these diplo-bacteria may assume a curved or sausage shape, which we may sometimes see intimated in the single organism, mature (Fig. 8). At other times, though not very frequently, the germ may appear in nearly its normal form, but one pole (coccoid) end will be semisegmented from its appositional end of the white substance by a constriction of the same at its line of attachment with the pole end (Fig. 9). This end will then be smaller than the opposite pole, thus giving a sort of pear shape to the entire organism: the small pole end is soon dropped, however, and becomes momentarily a free coccoid, and goes through the cycle of morpho-development already described; the same occurs with the other pole end.

This concludes my observations of the micro-morpho-biological phases presented by these two micro-etiological organisms in the course of their development. There may be some minor phenomena that have escaped my attention, but I am very sure I have described all the essential points.

The Swine Plague and Southern Cattle Plague Germs Differentiate themselves very sharply by their Appearance when Cultivated on Potatoes.

If we properly prepare (see text-books) and sterilize some nice, clean potatoes, and then place them (*lege artis*) in a sterilized, moist, cultivating chamber, and inoculate the cut surface of some of the potatoes from Agar Agar, Boullion or other cultivations of the microörganisms of these two diseases, we shall invariably find that they can be readily differentiated from one another in the course of from twenty-four to forty-eight hours after the surface of the potatoes has been inoculated. *The growth of the germs of the American Swine Plague will invariably present a peculiar brownish-yellow to the eye, reminding one of coffee color*, especially the variety one gets in the ordinary boarding-house and restaurant.[1]

[1] Colin says "greyish."

On the other hand, the micro-etiological *moment of the Southern Cattle Plague will with equal constancy present a growth of the most delicate straw color during the first day or so of its development, but which soon begins to show a delicate pinkish, red-yellow, and finally quite a decided brick-red-yellow shade, as the cultivation becomes antiquated; this reddish shade begins and grows most intense at the centre of the growth, leaving it more yellow toward its peripheries.*

The Deportment of the Germs of Swine Plague and Southern Cattle Plague in Beef-Infusion Gelatine.

As what is known to us as beef-infusion gelatine cannot be used in hot weather, or when the prevailing temperature is above 75° F. (23° C.), on account of its becoming fluid, I could not use this material until the last moment, and only prepared the first of the season on Saturday last, October 1, and on Sunday was enabled to inoculate tubes of this material with from pure cultivations of the germs of Southern Cattle Plague and hog cholera. This beef-infusion gelatine is an invaluable medium in the technique of bacteriology, for two essential reasons: First, being transparent, one can see what is going on on it, and, secondly, many micro-organisms cause the solid material to become fluid, and present peculiar phenomena to the eye, while others do not cause any change in it, but may grow in a peculiar manner.

Now the hog-cholera germs belong to the latter class, as well as the germ of the German, French and English swine plagues, which are probably identical with hog cholera, as also those of hen cholera, and the peculiar disease known as "wild Seuche" in Germany, which affects the deer tribe and cattle and hogs, and belongs to the same blood-poisoning group as hog cholera.[1] When we take our hog-cholera germ, and inoculate tubes containing this beef-infusion gelatine from the pure agar agar cultures, we shall observe that the germs do not cause the gelatine to become fluid, and that it never becomes so, so far as any influence of the hog-cholera germs goes, if the culture from which the material has been taken was a pure one, that is, contained no other form of micro-organismal life than the germs of hog cholera.

This germ, however, has other peculiarities; it slowly spreads

[1] The germ of the English Swine Plague was first discovered by me in 1886, in some tissues from England belonging to my then assistant, Dr. Bowhill, M.R.C.V.S.

over the surface of the gelatine as a delicate cuticle, but, as these cultures are made by puncturing the gelatine with a wire, the germs are carried into that substance by the wire. Here we observed that everywhere the wire has left a germ in its passage through the gelatine, that a small colony develops, giving to the puncture the appearance of a delicate thread with knots along its course. In the end these colonies unite, and give the puncture a ragged-edged appearance. As the germs of the German swine plague, and rabbit-septicæmia, and the "wild Seuche" all do the same thing, Hueppe asserts them to be the same organism. Hueppe has tried to claim that all these diseases were one and the same, a mistaken view, as I have tried to show.

I have now to chronicle the first serious error, a genuine mistake of carelessness, from undue haste, that I can charge myself with during my investigations of the two micro-etiological organisms here considered.

Above it was said that on October 2d two beef-infusion gelatine tubes were inoculated from pure cultivations of the germ of the Southern Cattle Plague, and in the local papers the following remarks were published:

"Now it became interesting to see how this Southern Cattle-Plague germ would deport itself in this gelatine, because it cannot be distinguished from that of hog cholera under the microscope, or on agar agar, or in bouillon. That it can be by its growth on potatoes has been already noted. Hence, on Sunday, October 2d, gelatine tubes were inoculated. You can judge of my surprise on seeing that this Cattle-Plague germ could be at once distinguished from those of hog cholera standing beside it. The germ of the former had caused the gelatine to become fluid to the bottom of the puncture in twenty-four hours, which is quite rapid work."

The above was scarcely in the hands of the readers of the two journals before I began to have grave doubts of the correctness of my observations, simply because *all other known germs belonging to this "belted" group, and the cause of extra organismal septicæmiæ, do not cause the gelatine to become fluid.*

In order that others may profit by an error which is unpardonable on my part, I will briefly tell how it came about. At the time I had just twenty agar agar cultivations of the germs of the Southern Cattle Plague, which I looked upon as pure, and which represented the outbreak at Tekamah and Roca, my inoculated

steer, and material from a ground squirrel. In making the gelatine tube, *I simply inoculated from one agar agar tube on two gelatine tubes, with no other precaution than a macroscopic comparison of the growth with those in the other agar agar tubes.* I could see no change in the appearance of the growth of the tubes I used. *I should have made, and every one should always make a few cover-glass specimens for the microscopic test in all such cases.* (In the case of these germs, it would be futile, however.) After the cultures in the gelatine had become fluid, I then inoculated the entire agar cultivations (twenty) upon gelatine, and carefully numbered each tube with a corresponding number, so as to control the number.

This time I was not at all surprised where in nineteen of the beef-infusion gelatine tubes no fluidification had taken place, the same occurring in the one as before and from the same agar tube. It is now February 6th, and the tubes remain exactly as they were on the 8th of October.

Hence, *the germs of the Southern Cattle Plague,* like those of the American Swine Plague, and other diseases of the same group, that are caused by the belted oval germs *do not cause fluidification of gelatine media.*

I next inoculated twenty pieces of sterilized potatoes (and for comparison's sake twenty others from cultivations of the Swine-Plague germ), and here *I found no change in the appearance of the growths from those previously described.* From the twenty potatoes culture of the Southern Cattle Plague germ I again inoculated twenty gelatine tubes. *Nineteen remained solid; one became fluid.* As the potato culture from the tubes which caused the gelatine to become fluid did not show any variation in the color of the growth upon agar agar from the others, I resorted to plate cultivations as well as the microscope to solve the riddle.

This one tube contained a small number of the most contemptibly small micrococci, yet enough to have got me into a serious error. They required 2,000-diameter amplification to see them distinctly, and, as I have said, Micrococci constitute a normal morphos in the development of this class of germs, their presence would have excited no suspicions had I subjected the original culture to a microscopic examination. Still it should be done in every case, so as to keep up a good rule.

They were separated with ease on plates. Inoculation upon Gophers with the mixed culture gave fatal results, but no cocci

could be found in their blood or tissues, nor did any develop in tubes inoculated from them. Inoculation upon Gophers and mice with pure cultivations of the troublesome cocci gave absolutely negative results, no disturbance except a little stiffness and swelling of the limb occurring.

The reason that the color of the agar agar, and especially potato cultures of the Swine Cholera-Plague germ was not affected by these cocci was that the former are so much larger and grow so much faster as not to be much affected thereby on that medium; while in gelatine this whole group of germs finds a poor nutrient material, and grow very slowly; on the contrary, the small cocci grew exceedingly fast in the gelatine, and also caused its fluidification with greater rapidity than any pathogenetic organism with which I am acquainted, not excepting Finkler's and the cheese "Comma." Second, they are almost transparent, and have no chromogenic properties.

That they had less specific gravity than the Southern Cattle-Plague germ could be determined by a microscopic examination of the material at the apex of the fluidification, by tipping the tubes gently; here the Southern Cattle Plague organism greatly predominated.

The Growth of the Germs of Southern Cattle Plague in Beef-Infusion Gelatine as Compared with those of the American Swine Plague.

While neither of these micro-organisms cause fluidification of the beef-infusion gelatine, still there are certain minor points which have a degree of differentiating value for each of them.

The germs of the Southern Cattle Plague have more desire for the air than those of the Swine Plague, they are more ærobic; *while they spread slowly over the surface of the gelatine, still they do it more rapidly than the swine-plague organism.* Along the line of puncture in the substance of the gelatine there is, however, no perceptible difference in the deportment of the two germs.

They each form individual colonies along the line, which gives to it an irregular jagged appearance, resembling the cutting edge of a saw.

If anything, this surface is more dentoid in the Southern Cattle Plague cultures than the Swine Plague growths in beef-infusion gelatine.

This concludes my present observations upon the development of these etiological organisms in and on different cultivating media. Not having a refrigerator, I have not compared their developments. upon blood serum up to the present time.

Now these facts of some of the biological (or life) characteristics of these two germs show that, while two germs may look alike and grow alike, even in every particular, they may have one other attribute which in such cases can only be relied upon to detect one from the other.

That is their origin or, in other words, their disease-producing action.

It needs no argument from me for the practical farmer to know that the Southern Cattle Plague will not produce hog cholera in his hogs, or the latter disease the Southern Cattle Plague in his cattle.

ON SOME INTERESTING DERIVATIONS OF MINERAL NAMES.

BY F. M. ENDLICH.

(Continued from January Number.)

3. In addition to those mineral names which have undergone curious changes in the course of time, there are others which show interesting etymological relations, and yet have descended to us in but slightly changed form.

KERMESITE is derived from the Sansk. *krimi,* worm; Pers., *kirm* or *kirmis,* scarlet; Ar., *alkirmis;* Sp., *alkermes;* G. obs. *Kermes,* the "scarlet bug," cochineal insect. *Chermes,* the druggists' name for the substance, reached Spain from Arabia and thence travelled to Italy and Germany.[1]

The Sansk. form *krimi* has been retained in our Engl. *crimson.* It is also recognizable in the Lithuanian *kirminis,* worm. In It., Fr. and, later, Sp., the letter *a* was substituted for *i* and *e*, resulting in *carminio* and *carmine:* whence the mineral name *Carminite.*

[1] "Chermes vocant Arabes vnde nos chermesinum; sev et vermilium vsurparunt quidam, a vermiculis exemptis a radice pimpinellæ; coccum autem alio nomine dicitur scarlattum." (Cæsius, 1636.)

AZURITE.—The immediate derivation of the word is from N. L. *azurum*, sky-blue. Originally it comes from the Pers. *ladyuward*, or *lazuward*. In M. H. G. the adjective *lassuvar* appears, which has survived in the H.G. under the form of *Lasur* and *Kupferlasur*, copper-blue.

During the reign of Emperor Augustus, about 20 B.C., the L. word *azulus*—Lapis Lazuli—is met with. (M. Vitr. Pollio, the architect.) Early in the fourteenth century the N. L. *asureus* occurs, the initial *l* having disappeared in Latin. In the recent forms—It. *azzuro*, G. *azur*, Fr. *azur*, Engl. *azure*—the original *z* takes the place of the N. L. *s*; but in O. Engl. the latter can be found :—

> . . . . . . "a broche of gold and assure,
> In which a ruby set was like an herte."
>
> —*Chaucer*, 1340-1400.

In the sixteenth century, however, the word had assumed its present construction :—

> . . . . . . "that deckt the azure field."
>
> —*Spenser*, 1552-1599.

Lapis Lazuli owes its derivation to the same source, and, like the G. Lasur, has retained the initial *l*. "*Azurri ultramarinum materia ex lapis lazuli*" (Cæsius, 1636), shows the Latinization of the It. word.

MARCASITE is derived from the Ar. *markashitsa*, pebble.[1] The word was introduced in the thirteenth century, and was especially applied to minerals which showed bright, metal-like lustre (*Kiese* of the Germans). It was known to Alb. Magnus (1280) under the form of *marchasita*, and he characterized it as a mineral out of which no metal could be extracted by fire. Two kinds, mainly, were distinguished—the one yellow, shining like gold (*pyrite, etc.*: "*Pyrites sine dubio Arabib. marchasita est*" [Agricola, 1546]); the other, purer and more valuable, like silver (*marcasita argeneta* of the alchemists, *bismuth*).[2] One characteristic of the *marcasites* was

[1] Personal communication from the Arabic scholar, Rev. Wm. Wackernagel, D.D.

[2] "Marchasitarum species multe ac diuersæ sunt, ... nam alia aurea; alia argentea; alia cuprea. ab igne non liquefit; sed per se comburitur." (Leonardus, 1610.)

that they nearly all contained "brimstone" (Cotgrave).[1] According to Boyle (about 1670), "*Marchasitical stones*" abound in those portions of the earth where the temperature is excessively high. From various old writers, it would appear that the Arabic physician Avicenna (about 1020) had previously used the name. A rather fanciful derivation brings the word from the Ar. *marv, kyass, idd*—whitish, glistening flint (Kobell).

4. Among the mineral names there are some which have retained their original form with surprising regularity and have distributed it through many languages.

JASPER descends from Heb. *iashpheh,* Ar. *iasheb* or *iashef,* Pers. *iashm,* Gr. *ἰάσπις,* L. *iaspis,* M. H. G. *jaspis,* O. Fr. *diaspre,* Fr. *iaspe,* O. Engl. *jaspe, jaspre,* Engl. *jasper,* H. G. and Sw. *jaspis.*

"His stone is jaspe."
—*Gower*, about 1360.

"The floore of jasp and emeraud was dight."
—*Spenser*, 1552–1599.

'*Ιασπις* is used by Plato (429 to 348 B.C.) and others after him; L. *iaspis,* by Virgil and Pliny, over eighteen hundred years ago.

SAPPHIRE is derived from Heb. *sappir,* Ar. *safir.* In Gr. the two *p's* of the Hebrew persisted, but the second was aspirated: *σαπφειρος.* M. H. G. used the word *saphir;* O. Engl. *saphire:—*

"Of rubies, saphires and of perles white."
—*Chaucer*, 1340–1400.

In It. the word has become *saffiro, zaffiro;* in Sp. *zafir,* Fr. *saphir,* Sw. *safir.* The H. G. and Engl. versions, however, retain the two *p's,* as in the Greek.

The It. *zaffiro* was perpetuated in obs. G. *zaffer,* used to designate blue cobalt-glass and blue colors; Engl. *zaffre* describes a purplish cobalt color.

Σαπφειρος was used by Dionysios Periegetes about nineteen hundred years ago, apparently in connection with the gem which now carries the name. Pliny also describes "sapphires," but evidently not the precious stone, as he states that it glitters with marks and specks of gold; this would apply to *Lapis Lazuli.*[2] Agricola (1546)

[1] Gessner (1565) claims the following: "*Pyrites recentiores marchasitam vocant, nostri corrupto nomine martistein.*"

[2] "*Sapphirus enim et aureis punctis collucet.*"—Pliny, Venice edition.

uses the correct orthography, "sapphirus;" as does Kentmann, in 1565.

ARSENIC.—The origin of this word is Gr. *ἀῤῥην*, or, as the second of two ς's frequently changes to a *σ*, *ἀςσην*=L. *mas*, strong, masculine. By transposition the word *ἀνης*=man, is formed from *ἀῤῥην*, the one *ρ* being dropped.

Homer uses *ἀνηρ*, 880 B.C., and, after him, all other writers. In Sophocles, however (497 to 406 B.C.), we still find *ἀρσην*, in the sense of strong; also in Aristophanes (412 B.C.).

"*κτυπος ἀρθην ποντου*" (noisy, powerful sea), Sophocles.

Theophrast writes *ἀῤῥενικον*, about 300 B. C.; Galenus (A. D. 131 to 202) employs *ἀρσενικον*, a poison. It is probable that the older forms were used to designate a variety of strong poisons, mineral or vegetable.

Curiously enough, the form *ἀρσην*, without the lengthening termination *ικον*, has survived in the G. *Arsen*, which signifies *metallic arsenic.* The Latinized form of *ἀρσενικον* or *ἀρσενικιον*, which latter was used by Aristotle (384 to 322 B.C.), is *arsenicum:* whence G. *Arsenik—i.e., arsenic oxide*—O. Engl. *arsenik* (Pettus, 1683) and Engl. *arsenic.*

DIAMOND.—Derived from contr. Gr. *a, privativum*, and *δαμαω*, I conquer=unconquerable. The name was originally given to hard steel and iron, and Hesiod uses it in this sense about 750 B.C. Since the days of Theophrast (about 300 B.C.) it has been applied to diamond. Gr., *ἀδαμας*.

The word enters Latin as *adamas.* "*Unde et nomen indomita quis Greca interpretationes accepit*" (Pliny). Pliny claims that when laid upon an anvil and struck with a hammer, the *adamas* will cause the latter to recoil and will remain unharmed, if, indeed, it fail to burst either sledge or anvil: hence its name. Only by sprinkling upon it the blood of a male goat can it be reduced to such a condition that it will no longer withstand the heaviest blows.[1]

In the middle of the sixteenth century the word was *Dyamant* in Germany; M. H. G., *Diemant;* H. G., *Demant* and *Diamant;* It. and Sp., *diamante;* Fr., *diamant;* O. Engl., *diamaunt;* Engl., *diamond.*

"Haue harte as hard as diamaunt—
Stedfast and naught pliaunt."

—*Chaucer*, 1340-1400.

[1] "*Adamantem opum gaudium infragilem omni caeteri et inunctum sanguine hircino rumpente quæque.*"—Pliny, Venice edition, 1559.

The original form of Gr. *ἀδαμας* has been retained in the Engl. adjective *adamantine*=diamond-like, and in other words:—

> . . . . "three folds were brass,
> Three iron, three of adamantine rock."
>
> —*Milton*, 1660.

MACLE is the name of a mineral which, when broken across its principal axis, shows a white cross or rhomboid spot enclosed within a dark matrix. The word is derived from L. *macula*, spot. G. *makel*, blemish; Engl. *maculate*, to spot, and *immaculate*, are from the same root, as is Fr. *macule*, spot. *Macula* is classical, and may have reached the Romans from Gr. *μαχελον*=inclusion, mark. *Pierres de macle* was applied to the mineral in 1751 by Robien. (Dana.) The meaning of Fr. *macle* is "*perforated rhomb*": whence its application to the mineral, which often shows such a figure on cross-section.

CARBUNCLE.—Pliny uses the name *carbunculus*, a diminutive of *carbo*=coal, in allusion to the resemblance of the gem to a glowing coal. In G. the *b* has changed to an *f*—*Karfunkel*—but remains *b* in Sw. *Karbunkel*. It is a coïncidence that the G. *funkeln* means glowing, scintillating. "*Carbunculi a similitudine ignium apellati.*" (Pliny.)

While the Greeks had a totally different name for the mineral, it is interesting to note that the origin of both the L. and Gr. words refer to the same peculiarity—*i.e.*, to some *glowing light*. The Gr. name is derived from *λυχνευω*=I shine brightly, I light up.

SMALTITE.—The Gothic form of *smalyan*, *smalteis*=melt, or smelt—was *smalzian* in M. H. G.; then *smelzan* (G. schmelzen); and these resulted in the M. L. *smaltum*=glass-flux. In the ninth century M. L. *smaltum* was used in the sense of smelted substance=*enamel*—in describing a "*crux pulcherrima gemmis et smaltis.*" (Anastasius.) It. *smalto* and G. *Smalte*, as well as M. L. *smaltum*, were finally applied to the blue cobalt glasses and cobalt colors, which became known about the middle of the sixteenth century. Since that time the word has retained its specific meaning. H. G. *Smalte* or *Schmalte*, Fr. *smalt*, Engl. *smalts*, Sw. *smalts*, all designate the color or substance known as cobalt-blue.

STANNITE is derived from L. *stannum*, originally *stagnum*. It is probable that the word is of Celtic origin; and the Irish *stan*, Welsh *ystaen*, may be regarded as direct descendants from the old root. Sueton and Pliny knew *stannum* as an alloy of tin and lead.

The old form of *stagnum* produced It. *stagno;* later, *stagnuolo:* whence obs. G. *Stagnol,* H. G. *Stanniol*=tin-foil. From the same source are Sp. *estano,* O. Fr. *estain,* Fr. *etain.*

In O. H. G., *tin* was *zin;* in A.-Sax., *tin*—possibly related to Sansk. *tshina,* lead; obs. G., *Zien* (1743); H. G., *Zinn;* Sw., *tenn;* D., *ten;* Engl., *tin.* The Engl. words *stannary*=tin-mines, and *stannous,* retain the Celtic (?) root. G. *Zinn* and *Zink* probably have a common origin, but the connection is obscure.

A derivation from A.-Sax. *tynan*=to shut, close, fasten, hence *solder,* has been suggested for tin, but seems untenable.

5. There are a number of mineral names which derive special interest from their application. The peculiarities ascribed to *Wolfram, Nickel* and *Cobalt* are productions of the German miner, whose fertile imagination saw more than mere matter-of-fact circumstances. Since the twelfth century mining has been prosecuted in Germany; and it can readily be imagined with what strange creatures the superstitious workman of those early days might people the underground domains.

WOLFRAMITE.—The word is of German origin, being a contraction of O. H. G. *wolfhraban.* The latter is formed by a combination of *wolf,* wolf, and *hraban,* raven. Among the ancient Germans, in fact, until the introduction of Christianity became general, the meeting with a wolf or a raven was considered a favorable omen under nearly all circumstances; and the most emphasized indication of coming good fortune consisted in meeting both of these animals. In the tin-mines of Germany and Bohemia, as well as in a number of silver-mines, the occurrence of *Wolframite* was an almost infallible index of the vicinity of good ore: hence the application of the name.

Wolfhraban contracts into *wolfhram* [*Wolffhram,* as late as 1565 (Fabricius)], and, by dropping the h, into *Wolfram.* *Wolf* was for many years a favorite baptismal name in Germany, and may be found to this day in some families of feudal descent. Wolf is derived from Goth. *vulfs* and A.-Sax. *vulf,* with the root of Goth. *vilwan*=L. *rapere,* to lay hold of, to tear.[1]

[1] *Wolframm* and *Wolffert* were used as late as the last century. The name is then explained as indicating that this mineral, when brought together with tin-ore in the furnace, wasted the tin—ate it up as a wolf

The Sansk. *karawa* is the root of Gr. *κοραξ*, L. *corvus*, It. *corvo*, Sp. *cuorvo*, Fr. *corbeau*, Engl. *crow*, G. *Krähe*, Sw. *Kraka*, D. *Kraye*, on the one hand, and, on the other, of A.-Sax. *cravan*, O. H. G. *hraban*, G. *Rabe*, Fr. *ravineux*, Engl. *raven*.

The derivation of Wolfram from *Wolf* and G. *Rham*=cream, is faulty. The Engl. name for G. *wolfram* is *tungsten*, der. Sw. *tungsten*, from *tung*, heavy, and *sten*, stone.

NICCOLITE, in this form of orthography, is derived from N. L. *niccolum*, the metallic element, formerly *nickelum* (latter part of eighteenth century). The Goth. *nickr* or *nickl*, A.-Sax. *nicr* or *nicor*, Icel. *nikr* (related to Icel. *hnickia*=to seize and carry off), was a demon who inhabited pools of water and drew down his victims with irresistible force until they were drowned. From the above is derived the G. *Nixe*, a female water-spirit, who was not always cruel, but sometimes gave her valuable services to unhappy lovers and others who sought hei aid. The G. masculine *Nix* belongs to the same family, but was a morose, objectionable character. His name serves to this day in Germany to drive children away from water. From the same source we have obtained the appellation "*Nick*," commonly used as "*Old Nick*," now employed as a *nom de plume* for the chief of the infernal regions, although the original association of the name with water is hardly in keeping with the orthodox conception of this warmly-located ruler.

In O. H. G. *nickel* signifies a small horse, especially a vicious one; also a dwarf. The A.-Sax. *nag* is related to it. Locally, the idea of a dwarf or stunted animal of any kind was modified into the personification of a malicious, mischievous spirit. In this connection, the words Engl. *nagging* (from A.-Saxon) and G. *necken*, to tease, were used.

The German miners frequently found ores which looked very promising, but, upon being smelted, they produced no silver: on the contrary, they emitted foul and noxious odors. The most natural explanation, at that time, seemed to show that wicked, envious spirits had changed the ores, or even infested them: whereupon the terms *nickel* and *kobold* were freely applied to such disturbing ele-

would. "Er (wolfram) betreugt die Berglente gar sehr, weil er mit dem Zinnstein vor dem Wasser stehet und im Schmeltzen das Zinn raubet." (Bergwerck's *Lexicon*, 1743.) *Wolfram* was also used for some arsenical ores which are objectionable in the furnace. (*Mineral. Belustigungen*, 1768.)

ments. An association of "*nickel*" with the name of any other metal expressed the old Germanic idea of a "*changeling*" (G. *Wechseling,* from O. H. G. *wihseline*), derived from the fancied changing of children by elves and fairies. Thus, *copper-nickel* would be the name of a mineral resembling copper-ore, yet containing none of the latter metal: the meaning would be equivalent to "false copper."

In this way the names of *nickel* and *kobold* became attached to certain minerals which resembled rich ores, but yielded neither silver nor copper. To this day the word nickel is applied to persons in certain parts of Germany when a giddy, or even vicious (generally female), character is to be described.

An ore known as *Kupfernickel* in Germany, *coppar-nickel* in Sweden, yielded a grey, hard metal to the Swedish mineralogist Cronstedt, in 1754, which he named *nickel.* He took the name from the ore. Promptly discerning that the metal he had obtained bore no relation to the first part of its name, copper, he selected the second. Thus the word which had first been applied by the miners was eventually attached to the metal which had caused them so much worriment.

Cobaltite is immediately derived from N. L. *cobaltum,* the metallic element. Agricola says (1546): "*Est præterea aliud genus ferrei quasi interdum coloris, cobaltum nostri vocant.*" In O. H. G. the word is *Kobolt,* sometimes *Kobalt*; in the sixteenth century, *Kobeit* and *cobelt,* or *cobel;* H. G., *Kobalt;* Sw., *kobolt.* It is a descendant of the Gr. *κοβαλος,* L. *cobalus,* whereby a familiar spirit was designated. This spirit was not necessarily vicious or ill-natured, nor prone to do harm, but he was full of mischief and fond of practical jokes. Aristophanes (about 406 B.C.) characterizes a *κοβαλος* as a satyr, a roguish fellow, in the following of Bacchus. The Fr. *gobelin* and Engl. *goblin* are derived from the same root. An amusing explanation of their etymology assigns Fr. *gober*= gobble, as their root and that of kobold, because nurses are apt to tell children tales of spirits that will "gobble" them as a punishment for disobedience and other childish peccadillos. (Minshew.)

In Germany the *Kobold* was rather useful than otherwise, unless he was crossed in anything.[1] Of a particularly industrious servant

[1] Of the "Berg-Kobelt" (mountain spirit) the following is said: "Es lässt sich in allerhand Figur sehen, bissweilen als ein kleines Kind, auch wohl als ein alter Bergmann, nur muss ihnen nichts in Weg gele-

it was said: "*Sie hat einen Kobold*" (a kobold is with her); and it was believed that this amiable spirit assisted her in her daily work. The underground association with nickels, however, must have tended to corrupt the kobold's kindly disposition and to sharpen his enjoyment of practical jokes, which he carried even to the point of cruelty. He disturbed and hid the tools of the miners, interfered with their timbering, changed their ore, and played a thousand distressing pranks. When the workmen proceeded to smelt silver from their ores, he caused the latter to emit mal-odorous, choking fumes in such dense masses as to injure the smelters. "*Kobelt'sche Ertze sind wilde und strenge Ertze.*" (1743.) The heavy, white smoke spread itself upon the grass of the fields and killed the cattle. At last the kobold became identified with this fuming, smoking class of arsenical ores, so that Mathesius, in 1562, describes cobalt as a "poisonous and injurious metal." Linnæus mentions arsenic (the source of the fumes) as Kobolt, and to this day the "*Scherbenkobalt*" of German miners is but a variety of metallic arsenic.

The metal cobalt was not extracted from its ores until Brandt, in 1733, produced it in a somewhat impure state. Its blue glasses and slags became known about the middle of the sixteenth century by accident: a workman secretly threw a piece of the evil-minded "kobold" into his employer's glass-furnace with the intention of causing the spirit to work dire mischief: the most beautiful blue glass resulted.

BASANITE is derived from Gr. *βασανος*=touchstone, probestone. It is used by Pindar in this sense as early as about 490 B.C. The word is formed from *βασανιζω*, possibly produced by contr. Gr. *βασις*, foundation, bottom, and *νιζω*, I wash, clean—conveying the idea of "*sifting to the bottom.*"

The Latinized form, *basanites*, was indifferently applied to black quartz, the true probestone, and to *basalt*, the eruptive product. It has been claimed that a "typographical error" on the part of some early copyist bore the responsibility of having produced the latter word. The transition from *basanites* to *basaltites* seems easy. Pliny (A.D. 70) uses *basaltes*, a marble from Ethiopia, and speaks of the name as having been used before his time.

get werden, so lässt es die Berg-Arbeiter auch zu frieden." (18*th Century.*)

It is known to be a fact that *basanites* was applied to true *basalt.* Agricola (1546) uses the word for an undoubted basalt; Gessner (1565) derives it from Gr. *βασανω,* and applies it to true basalt;[1] Kentmann (1565) calls it "black marble," and uses the word in the same way;[2] Basanite is described as "black stone" by Leonardus (1610), and he speaks of "*Bazanites sive Basaltem lapis;*" Cæsius quotes it as "*iron-colored*" marble, in 1636; in 1743 (Bergwerck's *Lexicon*) it was regarded as a dark-grey marble ("*schwarzgrauer Marmor*"); within the last fifty years *Basant* and *Basalt* have been used synonymously in various German publications. This confusion of the two terms may bear out the idea of an early "typographical error."

CELADONITE is formed from the Fr. *celadon*=sea-green. The origin of this word, in its quoted meaning, seems to be a curious one. Gr. *Κελαδων* first occurs in the "Iliad" (880 B.C.) as the name of a river; subsequently it is repeatedly used in the same way by Meleagros, Strabo a. o.; Ovid incidentally applied it, in the form of *Celadon,* as the names of two men, one from the mouth of the Nile, the other from the mountains of Thessaly. The word is derived from Gr. *κελαδος*=rushing noise, like that of rushing water.

In 1610 (1616?) a French novelist, D'Urfée, wrote a pastoral romance, "*Astrée,*" in which he gave the name of *Celadon,* borrowed from Ovid, to an inexperienced, insipid lover: whence the idea of greenness (Dana). Spanish (?), French and German all contain the noun *Celadon* or *Seladon*=verdant lover (G. *blöder Schäfer*), and the adjective=sea-green. In Engl. the latter has been amplified to *celandine.* In the acceptation of verdant lover, the word seems to have come from the Spanish rather than from the French, but it is difficult to arrive at its meaning for any given date. There was an ancient river *Celadon* in Spain, whence the word may have been introduced into that language. Thompson uses the name, in 1727, in "The Seasons," for Amelia's lover.

Dana gives the derivation from Gr. *κελαδων*=burning; others from *χελιδονιον*=swallow-wort. But neither seems to apply.

AMETHYST is composed of Gr. *a privativum* and *μεθυω,* I am

[1] "*His omnibus consideratis non immerito Misenus βαδανω, vel Basaltes Misenus dici potest,* EIN MEISSNISCHER PROBIRSTEIN."

[2] "*Marmor nigra Stolpense, ferreo colore et duricie, hoc Bisalten nominat Agricola; nos Basalten.*

drunk: hence it signifies a safeguard or amulet against inebriety. Some of the ancients claim that it prevents the latter, but Plutarch denies it. Among its numerous wearers of the present day, some may be able to judge of its supposed merit in this direction.

"Magorum vantitas resistere ebrietati eas promittit et nide appellatas."—*Pliny.*

The amethyst is mentioned by Plato (400 B.C.) and Asclepiades (280 B.C.) as a gem.

6. A few mineral names have reached us from the Anglo-Saxon with hardly a change and without having lost their characteristic brevity:—

WAD is a bog-ore of manganese. The word takes its origin from A.-Sax. *vaed,* bunches, derived from the Goth. *vidan*=to bind (in bunches). We further have: O. H. G. *wat, wetan, gawati;* M. H. G. *wat;* Scandinavian *vad;* Sw. *vadd*—related to G. *Watte* (cotton-), batting, and to Engl. *weeds.*

FLINT has been referred to Gr. πλινθος=tile or brick, and to Gr. πληττειν=to strike, in allusion to striking fire; but these derivations seem very problematical. The word in A.-Sax. was *flint;* M. H. G., *vlins;* locally (Middle German), *vlint;* O. Engl., *flent;* Sw., *flinta.*

"And out of flent sprang flod, that folke and bestes dron ken."
—*Langland,* 1362.

French *flin* means polishing material, for which powdered flint may be used. The word *flent* or *flint* may be related to the root of *flensing*=to skin, to flay (Icel., *flisia*), as in the earliest times flint, particularly, and other stone implements were used for skinning animals.

The form *flint* was assumed long ago:—

"Had ben my heart of flint, it must haue melted."
—*Surrey,* about 1520.

The H. G. *Flinte*=(shot-), gun, is the same word applied to firearms since about 1640, when they were first supplied with chips of flint or chalcedony for the purpose of striking fire and igniting the powder.

7. Matters of historical interest are also alluded to in mineral

names, but, usually, refer to some scientific work rather than to political occurrences.

TANTALITE is a name given by the Swedish mineralogist Ekeberg to a certain mineral in 1802. He thereby expresses the difficulties and tantalizing perplexities with which he was beset during the progress of his analysis of the substance. It is named after *Tantalos,* the well-remembered mortal favorite of the Olympian deities, who so far presumed upon his privileges as to place before them the remains of his own son, disguised as a tempting dish. For this sacrilege he was condemned to suffer hunger and thirst in the nether world, though surrounded by luscious fruits, viands and liquids of all kinds, which promptly receded from his grasp whenever he reached for them.

Certainly, the name forcibly expresses the feelings of the baffled chemist, while at the same time it affords a glimpse of the status of analytical science in 1802.

XENOTIMITE.—In 1832 the famous French mineralogist Beudant named a mineral Xenotime, apparently from contr. Gr. ξενος, a stranger, and τιμη, honor. He explained, however, that this name was derived from contr. Gr. κενος, empty, vain, and τιμη, honor, and added that he intended it to recall the fact that the Swedish chemist and mineralogist Berzelius vainly thought to have found in this mineral the metal *Thorium,* which he had named (1815) before its existence was really established (1828). The honor which Berzelius indirectly claimed in the supposed discovery of a new element was an empty one in this instance.[1]

As Dana appropriately remarks (*System Mineralogy,* p. 529), "there is a sneer at the great Swedish chemist in the name which should have occasioned its immediate rejection." If the word were correctly formed, so as to express what Beudant intended that it should, it would have been *Cenotime* or *Cenotimite* : hence the name, as he writes it, fails to convey the implied meaning. Dana has accepted the name *Xenotime,* as he explains, because it "may be

[1] "Conformément aux principes que nous avons adoptés, nous luis avons imposé un nom particulier, qui rappellera que le phosphate d'Yttria a été pris pour l'oxide d'un métal nouveau auquel on avait donné le nom de *Thorium,* apliqué aujour d'hui au métal découvert dans la Thorite." —*Traite de Mineral.* 1832.

regarded as referring to the fact that the crystals are small, rare, not showy, and were long unnoticed."

YENITE is a name given by the French scientist Le Lievre, in 1807, to a mineral found on the Island of Elba. The name was bestowed in commemoration of the battle of Jena, October 14th, 1806, in which Bonaparte almost annihilated the Prussian army.

Apart from the fact that the name should have been formed *Jenite* or *Jenaite,* the ungenerous spirit which prompted an introduction of political feelings into scientific matters was repudiated by Le Lievre's own countrymen, as well as by the displeased Germans: the name *Ilvaite*—from the L. name of Elba—given to the mineral by Steffens in 1811, was substituted for *Yenite.*

The hereditary rivalry between the French and German nations has found expression, within the last few years, in the naming of two newly-discovered elements: *Gallium* was named by a patriotic Frenchman, only to be followed by *Germanium* a short time after.

8. Naming minerals after localities is by no means an innovation, as the following examples will show:—

MAGNETITE.—About 400 B.C. the Greek term *λιθος Ἡρακλεια* was used by Plato to designate a mineral with magnetic power. Pliny quotes it as *Heraclion.* Probably it was named after Hercules (Herakles) in intimation of its strength (*lapis Herculeus* was used in the sixteenth century), rather than after the town of Heraclea in Lydia. Pliny claims that it was named after a shepherd, its discoverer.[1]

Later on, Dioscorides a. o. use the term *λιθος μαγνης,* describing a magnetic stone supposed to have come from *Magnesia,* a portion of Thessaly. *λιθος μαγνητης,* used by Dioscorides also, referred to soapstone or talc, so far as can be determined. (Dana and Pape.) The name reached Germany in the period of M. H. G. and took the form of *aget-stein* or *agt-stein.* It was applied rather indiscriminately, and apparently to amber by preference. The latter attracts small bits of paper and wool, etc., after having been subjected to friction.

[1] "Sideritin ab hoc alio nomine apellant, quidam Heracleon. Magnes apellatus ab inventore (autor est Nicander [about 150 B.C.]) in Ida repertus est." . . . "Invenisse autem fertur, clavis crepidarum et baculi cuspide hærentibus, cum armenta pasceret."

The Gr. *μαγνης* entered L. as *magnes*, thence passing into It. *magnete*, Sp. *magnetico*, Fr. *magnetique*, M. H. G. *magnes*, H. G. *magnet*, Sw. *magnet*, O. Engl. *magnes*, Engl. *magnet*.

> "On th' other syde an hidious rock is pight
> Of mightie magnes-stone."
>
> —*Spenser*, 1552-1559.

COPPER was obtained by the ancient Greeks from the Island of Cyprus. Homer speaks of it (880 B.C.) as *χαλκος*; and qualifies this term, which meant ore, bronze, metal or copper, by giving its color as *ἐρυθρος*=red. Later on the same name was applied to *iron*, and then the distinction *χαλκος Κυπριος*=Cyprian metal, was made, in order to avoid confusion. In L. the word *aes* is equivalent to the Gr. *χαλκος*; and the copper became known as *aes Cyprium*. (Pliny a. o.) By the end of the third century the word *aes* was dropped, and the descriptive adjective *Cyprium* evolved into the noun *cuprum*.

The alchemists gave copper the name and sign of *Venus*. *Κυπρις* is an old poetical name for Venus, used by Euripides (450 B.C.) a. o., and the Island of Cyprus was devoted to her cult.

From L. *aes Cyprium* and M. L. *cuprum* have sprung: A.-Sax. *cyper*, O. H. G. *Kuphar*, H. G. *Kupfer*, O. Fr. *cuyvre*. Fr. *cuivre*, Sp. *cobre*, Sw. *coppar*, D. *koper*, O. Engl. *coper*, Engl. *copper*.

> "Lyke as to a true syluer grote a false coper grote," etc.
>
> —*Sir T. More*, 1478 to 1535.

TURQUOIS is really an adjective=*turkish* (from Turkey), and is taken directly from the French. In Middle German the word was *turggis*; M. H. G., *turkoys*. In the middle of the sixteenth century this changed to *Türckis* and *Türkis*. The Sw. is *turkos*. N. L. forms are: *Turcois, turcosa, turchesia*; It., *turchesa, turchina*; Sp., *turquesa*; O. Fr., *turquoise*; O. Engl., *turques*; Engl., *turquois*.

> "I bequeth a ryng of gold, sette w^t a turques, a dyamaunt, and a ruby."
>
> —*Fabyan*, 1512.

9. There are a few names, familiar to almost every one, that have an exotic sound, foreign to that of the languages which have principally furnished the material for mineralogical nomenclature:—

TOURMALINE—also known as *Turpelin* during the last century, is derived from the Cingalese *turamali*.

Borax, a universally-known word, comes from the Ar. *buraq.*

Corundum (Fr. *corindon*) owes its form to the Hindostan *Kurand.*

Kaolin, the well-known porcelain-earth, was first mainly obtained from *Kau-Ling,* in China: whence its name.

A MONTH IN PALÁWAN.

BY J. B. STEERE.

THE island of Paláwan, or, as it is more frequently called by the Spaniards, Paráqua, is classed as one of the Philippine group. It runs from the northeast to the southwest, and is something over 250 miles long, while it hardly averages 20 miles in width. It fronts the China sea on the west, and the Sulu or Mindora sea on the east. It is distantly connected on the north and east with the other Philippines—through the Cuyos with Panay, and through the Calamines with Mindoro and Luzon; but it is much more closely connected on the south by Balabac and other small islands with Borneo. It is mountainous and heavily timbered, and but thinly inhabited, the native population being estimated by the Spaniards at ten or twelve thousand. The native people are of at least two races, Malays and Negritos. The southern end is chiefly inhabited by people of Malay race, to whom the Spaniards give the name of their hereditary African enemies, Moros or Moors. They are Mahometan in religion, and this, with the presence of their priests, has kept them more or less united, and perhaps a little in advance of the northern tribes. The northern part is inhabited by savages of Malay race, living in small, scattered tribes, and of Negritos—wooly-haired black people—living in much the same state, and apparently amalgamating with the Malays. The Spanish have had some small settlements of Christian Indians from Luzon, at the north, for some time, and for fifteen or twenty years have been forming a convict town at Puerto Princesa, on the east coast, and near the middle of the island. This now numbers some twelve or fifteen hundred inhabitants, mostly criminals shipped there from other parts of the colony. This is the capital and residence of the Spanish governor and other officers. Within a few years the Spanish have also formed small military settlements on the west coast.

Our party from the University of Michigan reached the island about the first of September, 1887, in the midst of the rainy season, but as the showers usually came in the afternoon, we were able to do a good deal of hunting and other collecting in the forenoon, while we spent the afternoon in skinning and preparing the collection of the morning. From lack of roads or other means of communication, our work was done chiefly on the low, heavily-timbered peninsula on which the town is built. We also did some work across the bay, along the little river Iguahit, and about a village of natives who called themselves Tagbaunas. The collections made by us during the four weeks of our stay numbered about seven hundred birds of some one hundred and twenty species; thirty mammals of five species; thirty amphibia of three species; one fresh-water turtle; fifteen lizards of six species; fifteen snakes of nine species; three hundred butterflies of thirty species; a few small and inconspicuous beetles, scorpions, and centipedes; ten or twelve species of corals from the shallow waters of the bay, and a large number of fine land and tree shells.

The island has been considered to belong to the Philippine group zoologically as well as politically—Mr. Wallace dividing the Indo-Malayan sub-region into three divisions: Java, Sumatra, Borneo, and Malacca, and the Philippines. Our work would seem to show that Paláwan is much more nearly allied zoologically to Borneo than are the other islands of the group, and probably more nearly allied to Borneo than to the other islands. This state of things seems to be especially shown in the mammals, in which the island is much richer than the rest of the group. It possesses, in common with Borneo and the other Philippines, the common gray monkey, *Macacus cynomolgus*, a species of Tupaia, one of squirrels, a wild hog, and one or two species of civet cats. In addition to these we found the manis or pangolin and the binturong, both common to Borneo, but wanting in the rest of the Philippines. We also became satisfied of the existence of a porcupine, *Hystrix*, a large round-tailed flying squirrel, *Pteromys*, and of a small species of the Mustelidæ, with powerful and unpleasant odor. Besides these Bornean forms there is probably also a species of tree-cat, Felis, and a mountain goat in the island. These species rest on the evidence of Spaniards and half-breeds capable of observing, and worthy of credence. In addition to these the savages declare that there is an orang outang in the interior. The mammals common to the rest of the Philip-

pine group and wanting in Paláwan are also noteworthy. Deer, present everywhere else, are said not to exist, and we saw no signs of them. The kaguan or Galeopithecus, one of the most common Philippine mammals, is apparently absent here. These facts seem to show that Paláwan has received its animal population from Borneo at a different time and through a different route than the rest of the group. The intervening island of Balabac possesses the common monkey, the wild hog, a true squirrel, a porcupine, an ill-smelling weasel; lacks the manis of Paláwan, but has a diminutive deer, *Tragulus*, common to it and Borneo.

In its birds Paláwan also shows its closer connection with Borneo. Among Bornean forms which do not seem to have made their way into the other Philippines, are the two beautiful genera of greenlets, *Iora* and *Phyllornis*; a three-toed woodpecker, *Tiga*; a true pheasant, *Polyplectron*, closely allied to the beautiful glass pheasants of Borneo and Malacca; and a frog-mouth (*Podargus*) bird, allied to the goat-suckers, but with the mouth parts (beak) heavy and hard. The Bornean look of our birds is quite apparent when we compare them with birds from the other islands, and careful study will probably show many more instances than those above mentioned.

Sun-birds, kingfishers, cuckoos, and swifts were especially abundant in species and individuals.

About September 20 we began to find large numbers of titlarks, snipes, plovers, and sand-pipers, and concluded that this must be the advance of the fall migration from the northwest. The only arboreal species which seemed to arrive at the same time was one of the warblers, Sylviidæ.

We undertook to make as careful notes of habits, height of flight, and feeding, character of foods, etc., as was possible in our hurried stay. Tropical species of birds seem to be much more nearly limited to specific kinds of food than those of temperate countries. A careful examination of the stomachs of our collection showed that some species lived entirely upon ants, others upon centipedes, others upon some special kind of fruit, etc., etc. The three-toed woodpecker noted above lives exclusively on ants, and these possibly of a single species—at least all of the same color; while a four-toed species (*Chrysocolaptes*), much like the three-toed one in size and color, lives on the common larval food of the family. One splendid long-tailed cuckoo, with beautiful metallic-blue coloring, bare spots of vivid crimson about the eyes, and immense light-green beak,

were exactly alike in the sexes with the exception that the male had eyes of cherry red, while those of the female were yellow—and this uniformly so through six or eight pairs procured. We shall take means for a more thorough study of the mammals of the island than was possible during our short stay. We have come on to the port of Zamboanga, in the island of Mindanao, and purpose to make a collection of the same character here.

INTELLIGENT SELECTION.

BY CHARLES MORRIS.

WHY do not distinct species of animals and plants appear as a consequence of man's selection and preservation of varieties? This is a question which has been asked more often than it has been answered, and which yet remains to some extent an open query. Among domesticated animals—dogs, pigeons, and a few other species in particular—the varieties produced by selection have been very numerous and well marked, yet they still remain dogs, pigeons, etc., and there is no generally accepted evidence that a new species has ever been produced by this method.[1]

Yet though much has been said on this question, it is by no means exhausted. There is one important circumstance which does not appear to have been considered, and which therefore gives warrant for a further review of the subject. It is not sufficiently borne in mind that the production of, and experiments on, varieties of animals and plants has been left almost entirely in the hands of ordinary industry. Science has come in to examine the results, yet has had little to do with the experiments. These have been governed almost solely by pecuniary considerations; yet it must be admitted that what may be admirably calculated to make money may be valueless to science, and that had a long series of experiments been conducted for scientific purposes alone, the results must have

[1] It is necessary to state, however, that many scientists hold that new species, and even genera, have been produced in domesticated animals. The carrier pigeon, for instance, is looked upon as a well-marked and persistent species, while variations in the dentition of dogs, of generic value, have been observed. Changes of this character are of the kind which it is important for scientific observers to endeavor to hereditarily transmit, and render permanent.

been widely different from those that have appeared, and may have been far more significant. That distinct species could have been thus produced is quite within the limits of probability.

We have named this process Intelligent Selection, as distinguished from Natural Selection. Yet in reality, though the former is conducted by man's intelligence instead of by the unaided influences of nature, there is no actual difference of principle between the two methods of selection. The changes which proceed with interminable slowness in the one case are greatly accelerated in the other; yet while Natural Selection is the work of nature unaided, Intelligent Selection is but the work of nature aided. The influences tending to favor and preserve variations which nature employs occasionally and slowly, are frequently and rapidly employed by man, and thus animals and plants exhibit wider variations under man's hands in years than they do under nature's hands in centuries. Yet the principles which control the preservation of varieties are probably much the same in both cases, and all that man has done has been to accelerate the process.

If, as is ordinarily believed, no new species or genera have been produced by man, though such have abundantly appeared in nature, a marked discrepancy would seem to exist between the action of Intelligent and Natural Selection. But it must be borne in mind that nature produces an extraordinary number of varieties as preliminary to every new species that appears. Ordinary variations are superficial, and of non-specific value. Variations in specific characters are probably of rare occurrence, and their preservation yet rarer. Possibly they only arise as resultants of a long series of minor variations in the same general direction. If such be the case it is not surprising that the superficial variations with which man has to deal seldom or never accumulate into characters of specific value—particularly in the lack of scientific direction.

Yet that species have not been produced by man is more an assertion than a demonstrated fact. If we take the varieties of dogs, for instance, such wide differences in size, form, and habits appear that many of these varieties, if found in nature, would be at once accepted as well-defined species. Yet it is declared that these distinctions are but artificial, and would very quickly disappear if the dogs were restored to nature. This assertion is ordinarily quietly accepted, yet it remains but an assertion. No one has ever proved

it. The fact is that while such dogs as preserve their natural instincts and conditions with little impairment might regain their original feral condition, those whose variation is extreme would simply die out. They could not survive in the struggle for existence if immediately removed from the artificial conditions to which they have been accustomed. Yet if two widely different varieties of dogs were slowly restored to nature, being protected and fed until they had learned the art of self-preservation without man's care, it is by no means improbable that they might retain their peculiar characters of form, habit, and adaptation to particular food, and if interbred for a considerable period might continue to interbreed. Though there is no proof of this, there is no disproof. It is an open problem, which can be settled only by experiment. The statement that all variational differences would disappear if any of the domesticated species were restored to feral conditions, is an unproved assertion, which cannot be verified without a much wider series of scientifically-directed experiments than have yet been made. Dozens of problems of this kind are settled in men's minds. Very few of them have been settled in fact.

It will be of interest, in this connection, to consider what has actually been done by Intelligent Selection, and the influences which have controlled its results. A mere glance at the subject shows us that industrial and pecuniary considerations have almost solely been at work. Among trees, for instance, the effort has been to select fruits of large size, agreeable taste, and early or late maturity. Among flower bushes, bright colors and odd shapes of petals, with variations in the size of the flower and its number of petals, have been the ruling considerations. Commercial value has been the sole thought, and superficial variations only have been preserved. A scientist would have watched for changes in the character of the pistils and stamens of the flowers, and if such appeared, by their careful preservation might in time have produced undoubted new species. Yet no extended series of experiments from this scientific point of view has been made, so far as the present writer is aware. Such changes may be of comparatively rare occurrence and inconspicuous, yet there can be little question that they occasionally arise, and they may be as susceptible to selective processes as any other variations.

Among animals the purposes aimed at by trainers vary in the case

of almost every species, yet they are, as a rule, all industrial. In the horse, for instance, the properties selected are speed, gracefulness of form, size, endurance, muscular strength, etc. In cattle milk-giving properties and delicacy of flesh are sought. Sheep are selected for fineness of wool and palatableness of meat. In swine pork-yielding powers are the sole consideration. Among domesticated birds, egg-laying powers are the main consideration in the hen, while in all these birds delicacy of flesh is particularly considered. Beauty of plumage and peculiarity of form are also favorite selective properties, and particularly in the case of pigeons, which have yielded extraordinary diversities in this respect.

In all these experiments but two considerations have ruled: the commercial value of the product, and its adaptation to man's pleasure. The money it will bring, and the enjoyment it will give to man's senses or his appetite, have been the overruling influences in the selection of varieties of plants and animals, and if any variation approaching specific value has been preserved, it has been through chance rather than design. The characters sought for have been superficial ones only, and in consequence superficial varieties mainly have been obtained.

Had this long series of experiments in selection been conducted by scientists, and for scientific purposes only, the results must have been widely different. The commercial value of the product might have been much less; the scientific value must have been much greater. Among the innumerable variations in form and character of animals and plants which incessantly appear, there must be some of more essential and less superficial significance than others. Only the eye of a trained scientist could discriminate between these, and by persistent selection of such variations, and neglect of all others, there can be no doubt that the question as to whether species can be produced by intelligent selection would have been far nearer settlement than it is now.

In the case of only a few animals has the consideration in selection been other than to aid in the support or to administer to the pleasure of man. Of the species in which wider purposes have ruled, the principal is the dog. In this animal there has been little tendency to subvert the natural instincts. Most of the domesticated species have been so diligently cared for by man that they have lost the ability to care for themselves, and the intelligence which they

possessed in their wild state has disappeared, and been replaced by no new intelligence. There are no more stupid animals on the face of the earth than the cattle and sheep of the farm. The hog and the horse are less so, the former because he has preserved some degree of feral independence, and the latter because his duties have required some degree of intelligence.

But the dog has protected instead of being protected by man, and has thus, except in some special varieties, retained its natural intelligence. And its employment under man has been such as to develop and preserve a new intelligence. The dog has been for ages man's companion. Its natural instincts have been retained, while upon them have been laid new instincts of the same general character; and its powers of observation have been very greatly widened and sharpened. It has been in contact with men mentally, and its own mental powers have been developed thereby. And finally selection, while devoted largely to peculiarities of form, has been yet more largely devoted to peculiarities of habit—to intellectual characteristics. Intelligence has been selected in dogs, and in this alone of all domesticated species.

Of the other species on which selection for intelligence might have been practiced, preventive circumstances have hindered. The cats are natively as independent as the dogs. But the domestic cat is only in a minor sense a tamed animal. In its reproductive habits it is a wild creature. In consequence selection has been almost impossible, and very few varieties of cats have appeared. Such as exist, indeed, are probably due to natural, not to intelligent selection. The monkeys, and particularly the higher apes, would be remarkably well adapted to selection for intelligence, but unfortunately they do not breed well in captivity. The anthropoid apes indeed, not only do not breed, but have never lived long in captivity, so that this promising field of selective experiment is practically closed. What results might arise could a fertile domestic race of orangs or chimpanzees be produced, it is not easy to decide. The marked intelligence and teachableness displayed by individuals, with no hereditary powers but those derived from a wild-woods life, is significant of remarkable developments could they be made to breed in captivity. It would not be easy to give them new vocal organs, and teach them to talk, but by long-continued selection their brains might be developed in size and power until they became the equal in intelligence of some of the lowest savage tribes of man.

Dogs are the only species which promise good results in selection for intelligence, and it is highly desirable that experiments on them, with this purpose in view, should be made. The desultory selection which has been practiced has given excellent results in this direction, while many instances of high intelligence in individual dogs have appeared. But no breeder seems to have made it his business to make this intelligence the basis of his selective operations, though it has been done to some extent without design, in the effort to preserve high-bred varieties. It is desirable that a series of scientific experiments with this object in view should be undertaken, the intelligence of individual dogs being awakened as fully as possible, and the same training applied to the offspring of these dogs during a number of generations. The result could scarcely fail to be of interest and importance.

In fact it is desirable that scientists should give some attention to the general subject here considered—that of intelligent selection of varieties of animals and plants for other purposes than those of commerce. Many results not now dreamed of might thus be attained, and the problems of the origin of species and the limits of animal intellect be brought nearer to solution. When such extraordinary results have been produced by the chance methods of selection of superficial traits so far practiced, the adoption of scientific methods and the selection of more significant characteristics would very likely yield varieties of the utmost interest and value to science.

EDITORS' TABLE.

New popular scientific journals are appearing or are announced from time to time. We have received the first number of the *American Geologist*, which is published at Minneapolis. As its title implies, its field embraces geology and all the immediately allied and subordinate sciences. Its editorial corps embraces some of our most able and accomplished geologists. It deserves success, and our country is large enough to ensure this, if its people are sufficiently interested in the subject to subscribe for it.

Another important journal is announced by a New York company, to be called *Garden and Forest*, which is to be a Journal of Horticulture, Landscape Art, and Forestry. Its editors are to be Professors C. S. Sargent and W. G. Farlow, of Harvard, and Professor A. S. Packard, of Brown. This journal is designed for a comparatively wealthy constituency, and will not be, apparently, exclusively scientific, although its editorial corps is highly so.

So far as the publication of new scientific journals is concerned, we cannot have too many of them if they are well backed or sustained, financially. Unless this be the case, however, we regret the loss of time and labor which they cause to their projectors and contributors. Experts in science are not sufficiently numerous in this country to enable us to spare any of them for popular work, unless they are so compensated as to prevent any actual loss to their scientific efficiency. It may be safely assumed that every really meritorious work of a specialist which is produced in this country will have ten translators, even if his work reaches the American public by way of Europe, before it is appreciated. It is easier to compile than to produce.

We have had some experience of the financial aspect of the question. The perils are many and various. The NATURALIST, although now in its twenty-second year, has escaped shipwreck by little less than a miracle several times. But the maxim, "while there is life there is hope," has been as often verified, and the vigorous constitution which comes of—modesty forbids us to say just what—has triumphed, while many of our contemporaries have "joined the majority"—of popular scientific journals.

RECENT LITERATURE.

CLAYPOLE'S "THE LAKE AGE IN OHIO."[1]—The course of the terminal moraine in Ohio is westward from the New York line to about the middle of the State, after which it swerves south and southwest so as to cross into Kentucky. "The ice," says our author, "*dammed the Ohio River above the site of Cincinnati*," forming a sheet of water which he names "Lake Ohio." As the banks of the Ohio are 400 to 500 feet high at Cincinnati, the ice must have been thicker than this. If assumed at 500 feet, the rim of the ice would be 365 feet above the level of Lake Erie. The entire south of Ohio, a large portion of West Virginia, and portions of Kentucky and Pennsylvania, including the site of Pittsburgh, must thus have been under water, forming a lake some 400 miles by 200. Professor Claypole, from the mass of the moraine, and other reasons, assigns considerable time to the life of this lake before the ice-dam gave way, at first to be repaired every winter, at last utterly.

When the glacier, in its further retreat, had crossed the water-shed, the waters formed by its melting, unable to escape towards the north, formed a series of smaller lakes in what are now the valleys of rivers flowing into Lakes Erie and Ontario. As a consequence of the still farther retreat of the ice, these lakes became confluent, the water was drained away from those that lay highest, and carried off through the lowest water-gap, paving the way for the formation of Lakes Erie and Ontario, which at one stage formed a single vast sheet of water.

For some time a narrow ice-dam stretching across the St. Lawrence valley held the waters of this great lake at a level of 700 feet above the sea.

Professor Claypole traces the various steps of the ice retreat and lake formation with much care, and illustrates his argument with four maps. W. N. L.

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GEOGRAPHY AND TRAVEL.[1]

ASIA.—CAREY'S JOURNEY IN TURKISTAN.—The enterprising English traveler, A. D. Carey, who in May, 1885, left Simla, furnished with a passport from the Chinese Government authorising him to travel in Turkistan, China, and Tibet, has returned to London, and on November 28th read an account of his journey at a meeting of the Royal Geographical Society. His route lay through the Kulu and Lahoul valleys and across the Buralacha Pass to Leh, where he was joined by Mr. Dalgleish, his Turki interpreter and assistant. From Leh to Turkistan his route lay through the uninhabited tract of Tibet lying between Rudockh and Polu. He considers the route useless for trade purposes, since it runs for some distance at a height of 16,000 feet, is impracticable for luggage animals between Sulphur-Horse Pass and Polu, and enters Turkistan at too distant a point from Yarkand and Kashgar. The Chinese authorities at Kiria were ignorant of the existence of this route from India, and were thrown into consternation by the traveler's arrival. Within the area of irrigation of the Kiria river agriculture flourishes, and fruit, cereals, vegetables, and trees are abundant. The travelers met with great respect here. A good bridged road connects Kiria with the busy manufacturing town of Khoten, where carpets, silk, felt, and copper and brass vessels are made. The population is said to be about 30,000, but it was evidently once much larger, as ruins of an old wall which included the sites of the present separate Mohammedan and Chinese towns can be traced. The travelers followed the Yurangkash to its junction with the Karakash, and then proceeded along the wider stream (the Khoton) to the Tarim. After visiting the towns of Shah Yar, Kuchar, Karashahr, and Kurla, Mr. Carey pushed on to the Lob-Nor district. Miserable poverty seems the main characteristic of the Mussulman Turki-speaking natives of the Lob district, against whom their neighbors higher up the Tarim are much prejudiced. On April 29, 1886, Mr. Carey started for a pass over the Altyn Tagh, but the guide lost his way. After being compelled to burn the ridge-pole of a tent for fuel, the less barren valley of Bokalik was reached. After wandering in the mountains, guided only by a compass and sextant, for eighty days without seeing a human being, the party came upon several hundred armed pilgrims, and found that they were between the Kuen-Lun and Khokosili ranges, just south of the Angirtakshia Pass, and south of the Naichi valley, the point aimed at. Here much difficulty was experienced in procuring food,

[1] Edited by W. N. Lockington, Philadelphia, Pa.

as the supplies of the natives had run short. In the course of a journey to a place called Hoiduthara in quest of barley, Mr. Carey and his Tartar (Daspa) were the recipients of great kindness from a young Lama, who, observing the exhausted condition of the pair, rode to the town and ten miles back to bring them food. After 37 days the two rejoined Mr. Dalgleish with supplies.

Hajjar, the residence of the chief of the Thaichinenr Mongols, was next reached. Our traveler characterizes the Mongols as timid and poor, and so accustomed to being cheated by Chinese that they cannot believe anyone will treat them fairly. Makhai, the Saithang plain, and Sachu were the next points—the last a Chinese town built of sun-dried bricks, mud, and timber. At Hami, a Belgian and two Russians were found. At this point the travellers turned westward, and after passing by Pichan, (the frontier post of Kashgaria under Yakule Bey) and Turfan, made an excursion to Urumtsi, the headquarters of the Chinese Government of Turkistan. They then pushed on to the previously visited town of Kurla, and returned to Ladakh via Kuchar, Aksu, and Yarkand.

Mr. Carey has thus visited almost every important place in Chinese Turkistan except Kashgar, and he states that it is for the most part purely desert, the only really good strip of country being in the west, and composing Kashgar, Kargalik, and Yarkand. The Chinese give complete religious toleration, repress crime well, and maintain a high prestige.

THE TARIM DISTRICT.—The Tarim river had, in October, 1885, a depth of three to five feet, and a width of about 135 yards at the confluence of the Yarkand and Khotan. In summer the depth and width, as stated by the natives, and proved by the state of the river-bed, are thrice the above. It is only in summer that the Khotan-daria flows into it. The Tarim thus seems to be navigable for steamers from the confluence of the Yarkand and Khotan to the Lob-Nor.

The map in a recent number of the *Izvestia*, embodying the results of the fourth journey of General Przewalski (Prejevalsky) in Central Asia, shows that the depression of the Lob Nor must not be confounded with the Eastern Gobi, which latter is more elevated, and falls by a steep terrace towards the depression of the Lob-Nor. Thus the Tarim region is a depression of the high plateau of East Asia, limited on the east as well as on the north, west, and south.

THE MOUNTAINS OF SIAM.—Mr. J. McCarthy, who has for seven years been superintendent of surveys in Spain, states that the chain of mountains which runs on the west in an unbroken range to Singapore, has peaks of 7,000 feet between Burmah and Siam, while one peak in the Malay Peninsula reaches 8,000 feet. The eastern range,

which forms the watershed between the rivers flowing into the Chinese sea and the Meinam Kong (Mekong), has peaks of 9,000 feet. Another range, which leaves the western range near Chingmai (Zimmé), forms the watershed between the Meinam and Meinam Kong valleys. Famous salt wells exist in this range at the source of the eastern branch of the Meinam.

AFRICA.—M. DOULS' ADVENTURES IN THE SAHARA.—M. Douls, disguised as a Mussulman, landed from a Canary Island fishing boat at a point between Cape Bojador and the Rio de Oro. The first Moors he met suspected him, and made him a prisoner, but by persevering in his rôle he was finally admitted as a brother into the tribe, which proved to be a section of the terrible Ulad Delim, the robbers of the Western Sahara. For five months he wandered with them, exploring the desert of Uaran and Djuf, the great depression of the Sahara. In March last he was at Tendûf, the great slave market of the Northern Sahara. This oasis has greatly increased in size since Dr. Lenz's visit in 1880. Taking leave of the nomads at Glimin, he proceeded across the Atlas through the country of the Berbers of Sus to the city of Morocco. Here he was suspected and thrown into a dungeon, but was fortunately liberated through the representations of Sir Kirby Green, the English ambassador, who reached the town the same evening.

LIEUT. WISSMANN'S SECOND JOURNEY ACROSS AFRICA.—Lieut. Wissmann has returned from his second expedition across Africa. His route was from Angola to Luluaburg in the empire of the Muata Yambo, thence to the Lubi, which, after an excursion to the country of the Benangongo, they followed to its confluence with the Sankaru; thence eastward through a vast belt of primeval forest inhabited by Batetela and the dwarfish Watwa; then through the country of the Beneki to the Lomami and Nyangwe, whence he reached the Eastern coast by way of lakes Tanganyika and Nyassa. The slave trade is flourishing east of the Saukura, the Bassonge and Bassenge being the chief offenders, often supported by slave-traders. The country of the industrious Beneki was entirely devastated.

AMERICA.—SUBMARINE VALLEYS OF THE CALIFORNIAN COAST. —Prof. Geo. Davidson (*Bull. Cal. Acad. Sci.*) describes the submarine valleys discovered off the Pacific Coast of the United States. Within forty or fifty miles of the shore south of Cape Mendocino the plateau of the Pacific reaches a depth of 2,000 to 2,400 fathoms. There is usually a marginal plateau ten miles wide to the 100 fathom curve, beyond which the descent is sharp to 500 or 600 fathoms. In this marginal plateau several remarkable valleys have been discovered. One of these is in Monterey Bay, heading to the lowlands at the bend of Salinas river; and another off Point Hueneme, at

the eastern entrance of the Santa Barbara channel; there are one or two off the southern point of Carmel Bay, while the deepest one reaches far into the bay. Near Cape Mendocino, just north of a submarine ridge extending from Point Delgada to Shelter Cove, is a deep valley which breaks through the marginal plateau and runs sharply into the immediate coast line. The head of this valley, at one and one quarter miles from shore, is 100 fathoms deep; where it breaks through the 100 fathom line it is 400 fathoms deep. The slopes of the sides are very steep. Midway between this and Point Gorda is another valley 150 to 300 fathoms deep, reaching 520 fathoms where it breaks through the 100 fathom line. Another valley between Point Gorda and Cape Mendocino is 450 fathoms deep at a point six and one half miles southwest by south from the cape. This valley is a wide one, with green mud at its bottom.

EXPLORATIONS ON THE YUKON.—Dr. G. M. Dawson and party left Victoria in May last with the object of exploring the tributaries of the Upper Yukon. He proceeded up the Stikine River as far as Dease Lake, and when, on June 18th, the ice broke up, went down the Dease River and into the forks of the Dease and the Liard. Mr. McConnell here separated from the party with the purpose of descending and surveying the Liard and Mackenzie, and will probably winter at Fort Simpson, on the latter river. Dr. Dawson went up the Liard and Frances Rivers to Frances Lake, which drains into the Liard; then made a portage of fifty miles to the Pelly River, which they descended to the confluence of the Pelly and Lewis; and then ascended the Lewis, crossing the Chilcot portage to the head of Lynn Canal.

GEOGRAPHICAL NEWS.—Mr. Cuthbertson has reached the summit of Mount Obree, one of the culminating peaks of the Owen Stanley range. He makes it only 8000 feet high, instead of 10,246, as was determined by angular measurements taken by the *Rattlesnake* expedition. He states that at 2,500 feet above the sea he passed the point reached by Messrs. Hunter and Hartmann.

The population of New Zealand in March, 1886, exclusive of Maoris, was 578,482, an increase of 33,549 over that of 1881. The figures include 4,527 Chinese, only 15 of whom are women. The Maoris number 41,969, and 2,254 half castes living with the Maoris.

M. Marche has paid a visit to Saïpan, in the Marianne Group. No trace of a volcano or volcanic rocks, such as have been reported, was found, and Tapochas, the highest peak, was by barometrical

measurement found to be 1,345 feet high instead of 2,000, as formerly supposed. The other hills reach 600 to 700 feet. There is very little fresh water.

The Danish Government has decided to despatch an expedition to Iceland this coming summer, to effect hydrographical measurements. Great fiords and waterways still remain unmeasured.

The "Statistique de la Superficie et de la Population des Contrees de la Terre," by M.E. Lavasseur, gives the following table of areas and populations for 1886:—

	Area million of sq. kilometres.	Population. In millions.	Population. Density of sq. kilometre.	Population. Ratio to total.
Europe	10.0	347	34	23.4
Africa	31.4	197	6	13.3
Asia	43.0	789	19	53.1
Oceanica	11.0	38	3.5	2.6
North America	23.4	80	3.4	5.4
South America including Australasia	18.3	32	1.7	2.1
	136,1	1,483	10.9	100

Nearly two-thirds of mankind are concentrated in about eleven millions of square kilometres, viz.: West Central and South Europe (245 millions of inhabitants, 3.5 millions of kilometres); the Anglo-Indian Empire (254 and 3.6); and China, Manchuria and Japan (430 and 4).

Dr. Krause has arrived at Accra on the Gold Coast absolutely without means, having been compelled to leave his collections and baggage behind through the opposition of the natives.

M. J. Thulet, from observations taken on the *Clorinde* combined with those of Mr. Buchanan on the *Challenger*, has prepared a series of longitudinal and transverse sections of the Gulf Stream. It is like a river, and has a steeper slope towards the United States than towards the ocean. The great St. Lawrence current, coming from between Cape Breton Island and St. Paul, collides with the Gulf Stream, lessens its speed, and leaves as a sort of submarine delta the banks extending along the United States coast to the great bank of Newfoundland. The eastern polar current skirts Newfoundland, strikes the Gulf Stream at right angles, and since its waters are a little *lighter* than those of the Gulf Stream, mixes with them, and almost entirely arrests them. The cooled waters spread out in a general north-easterly direction, but there is no longer any definite current.

The researches of General Tillo on temperature have led him to conclude that the continents are, as a whole, 3° cent. colder than the oceans between the latitudes of 90° N. and 50° S. The New Continent is 3° colder than the Old; and the Atlantic 2.6° colder than the Pacific. The northern hemisphere contains 14 per cent. of the cold regions, 35 per cent. of temperate, and 51 per cent. of hot regions. Dr. Supan's estimate, reached by a different method, gave 15, 32 and 53 per cent. for these regions.

GEOLOGY AND PALÆONTOLOGY.

THE VERTEBRATE FAUNA OF THE PUERCO EPOCH.—I have recently revised my material representing this fauna, and have added eighteen species to those already known. One of these belong to a new genus, viz.: Onychodectes, allied to Conoryctes (Creodont).

The Puerco formation lies on the Laramie in North Western New Mexico and South Western Colorado, and is largely covered by the Wasatch Eocene in both regions. It was discovered by the writer in 1874, at its eastern outcrop of about 500 feet thickness, and was identified by Endlich and Holmes in Colorado, in 1876, where the thickness reaches 1000 to 1200 feet. On the San Juan river, its thickness is 700 feet, while at its western outcrop, south of that river, its thickness is 800 or 900 feet. While the formation possesses lithological peculiarities, no clue to its importance in geologic chronology was known until the discovery of vertebrate remains was made in 1880, by Mr. David Baldwin. With the evidence derived from this material the writer has been able to interject into the series of epochs of geological time a period which must have possessed many peculiarities, and which differed in such important essentials from those which preceded and from those that followed it, that an immense interval between them is proved to have existed, such as had not been previously suspected. The rich fauna which it contains displays characters which indicate others yet to be discovered before connections with other epochs both prior and subsequent can be known.

The vertebrate fauna includes up to the present date one hundred and six known species. Four species of Mollusca have been discovered, which have been determined by Dr. C. A. White, of the U. S. National Museum. They are *Unio rectoides* White; *Helix adipis* White; *H. nacimientensis* White, and *Pupa leidyi* Meek. The first named is found in the Wasatch, and the last in the Laramie; the two other species are peculiar. Besides these, the only other indications of organic life at that period is petrified wood of undetermined trees, which is quite abundant.

The character of the vertebrate fauna is indicated by the following table:

Reptilia	12	Bunotheria	52
Crocodilia	3	Tæniodonta	3
Testudinata	5	Creodonta	49
Rhynchocephalia	3	Taxeopoda	28
Ophidia	1	Quadrumana	4
Aves	1	Condylarthra	24
Mammalia	93	Amblypoda	2
Marsupialia	11		
		Total	106

In 1874, the writer advanced the proposition that the ancestors of modern placental mammalia would be found to be "plantigrade pentadactyle bunodonts." This anticipation was partly realised in the fauna of the Wasatch epoch subsequently discovered, but is completely so, in the characters of the mammalia of the Puerco epoch. All the placentals, and probably the Implacentals also, were "plantigrade pentodactyle bunodonts." More than this, the placentals nearly all present the primitive type of dendition of the maxillary series, since the superior no less are nearly all of the tritubercular type. But four species out of the eighty-seven placentals are quadritubercular. In the inferior molars the tuberculosectorial, or quinquetubercular type of dertition is extensively prevalent, but not so generally so as the superior tritubercular. Thus of the eighty-seven placentals sixty-four present the primitive type.

In its relations to other faunæ, the Puerco is totally distinct as to species. No species comes to it from an earlier epoch, and none continued unchanged after it. Of genera not widely distributed in time, one of lizard-like Rhynchocephalia, Champsosaurus, comes over from the Laramie, with a genus of tortoises Compsemys. Another genus of tortoises, Dermatemys, probably commences at this epoch, to continue through the Wasatch and Bridger Eocenes to the present time, since it still exists in Mexico. Among Mammalia, one genus only continues later, since Didymictis is found in the Wasatch and Wind-river formations. None other continues after the close of the Puerco. Not only this, but the entire family of the Periptychidæ ceased at that period. The same is true of the Amblypod family Pantolambdidæ. One of the most important features of the fauna is, however, the presence of eleven species of the Marsuspialia Multituberculata, a suborder which commenced in the Triassic age, and which terminated its existence so far as the Northern Hemisphere is concerned, with the end of the Puerco epoch. This series of animals gives a Mesozoic character to the fauna, which is not necessarily counterbalanced by the characters of the remaining types. The placentals are in all probability those which existed during the latter part of Mesozoic time, and the absence of some of the forms of the Eocene increases the weight of the impression thus produced. Thus two orders

universally present in the Eocenes, the Perissodactyla and the Rodentia, are wanting from the Puerco.

In conclusion it may be safely assumed that in the Puerco fauna, we find the ancestors of the species of Eocene and of later times. In the Tæniodonta we get ancestors of Tillodonta and probably of Rodentia and Edentata. In Creodonta we get the ancestors of the Carnivora, in the family of the Miacidæ. In the Condylarthra, we get the ancestors of the Diplarthra and Amblypoda, and in the Puerco Amblypoda the ancestors of those of the following epochs. Hence the investigation of this fauna possesses an especial interest for the mammalogist and for the evolutionist, as well as for the geologist proper.—*E. D. Cope.*

Schlosser on the Cænozoic Marsupials and Unguiculata.[1]—The first part of this work contains all of the Unguiculata, except the Edentata, Rodentia and Carnivora. The last-named order will form the second part. The work is an important one, in quarto form, and the first part is illustrated with five plates. This supplements the American works on the same subject and brings it up to the present time, with minor exceptions.

The present author shows throughout, his fine appreciation of the points of structure of the vertebrate skeleton, and he makes judicious use of them, from a systematic point of view, although one observes, perhaps, a tendency to rather more minute taxonomic division than the circumstances warrant. The work is also characterized by a thorough acquaintance with the literature of the subject. Important additions to our knowledge are made in every department.

We can only mention here the descriptions of the little-known genera of Von Meyer—Dimylus, Cordylodon and Oxygomphius, the first two remarkable forms of Insectivora. To the Creodonta he adds the new genus Pseudopterodon, which is founded on a species of about the size of a fox (*P. ganodus*), allied to Pterodon.

Dr. Schlosser continues to exclude the Miacidæ from the Creodonta; but he has not been aware that Scott shows that the lumbar zygapophyses have the characters of the other members of that order or sub-order. For some unaccountable reason he places Esthonyx in the Edentata. Numerous important additions are made to the Chiroptera, in the genera Vespertiliavus and Pseudorhinolophus.

One of the most striking discoveries recorded is the fact that the supposed canine teeth of the Lemurs of the present period are really the anterior premolars, as in the Artiodactyle genus Oreo-

[1] Die Affen, Lemuren, Chiropteren, Insectivoren, Marsupialier, Creodonten u. Carnivoren d. europäischen Tertiärs, von Max Schlosser. I Theil. Alfred Hölder. Wien, 1887.

don. This obvious fact has, curiously, escaped the observation of all the numerous naturalists who have studied this group. As a consequence, he separates the eocene forms, which have all true canines in the lower jaw, as a distinct sub-order—the Pseudolemuridæ. Should this be really a sub-order, the name Mesodonta would have been the proper one to employ; but if a family only, then the term Adapidæ is applicable—which is, indeed, used by Dr. Schlosser in a restricted sense. Most of Dr. Schlosser's new material is derived from the French phosphorites.

We congratulate the author on the fact that no person can study this subject henceforth without the aid of this memoir.

LYDEKKER'S CATALOGUE OF FOSSIL MAMMALIA IN THE BRITISH MUSEUM, PART V.[1]—We have in this part of Dr. Lydekker's Catalogue a valuable contribution to the subject of which it treats. The light thrown on questions of affinity and taxonomic usage is considerable, and supplements from a conservative stand-point the opposite tendencies of Dr. Schlosser. Our own view of the case leads us to adopt in most cases the *aurea mediocritas* between these two distinguished cultivators of the science. There is one point, however, in which we are compelled to agree with Schlosser and not with Lydekker, and this in a question of scientific purism of which the latter is in all other cases so able a defender. This is in the matter of requiring a description,—whether good or bad matters not as to the rule,—for a genus and other division above species, as an essential basis for a nomenclature. *E. g.*, in the "Catalogue" we find the name Platychœrops used instead of Miolophus, although no reason for the separation of the former was ever given by its describer. Perhaps no description was given to Miolophus either. In that case Dr. Lydekker has the right to select whichever name he prefers, or to give a new one. One other point. On page 161, under the genus *Nototherium* Owen, we read, "Since this is the only known genus, its characters are the same as those of the family." Now, no one knows better than the author of this excellent series of works, that this cannot be the case!

Of course it is impossible for an author to keep pace with rapid additions to knowledge made in other countries. We only call attention here to the additional definitions of the Creodonta to be found in Professor Scott's late memoir on that order, and refer to my own later studies, now in press, on the fauna of the Puerco Epoch. But we object to the slight value attached by Dr. Lydekker to the presence or absence of the scapholunar bone in this order (p. 305). Finally, we rise to two questions

[1] Catalogue of Fossil Mammalia in the British Museum, Part V., containing Tillodontia, Sirenia, Cetacea, Edentata, Marsupialia, Monotremata, and Supplement. By Richard Lydekker, B.A., F.G.S., etc. London. 1887.

of privilege. The first point is found in a foot-note on page one, viz.: "Cope (*Vert. of the Tertiaries*, p. 195), who regards the outermost cutting-tooth as an incisor, states that it is absent in Tillotherium and present in Anchippodus, and that in the former there are seven and in the latter six cheek-teeth." This paragraph commits me to two errors of which I am not guilty. Let "outermost cutting-teeth" be changed into *innermost* cutting-teeth, and I am correctly quoted. As to the cheek-teeth, I state that my information as to Tillotherium is derived from Marsh, and as to Anchippodus I give the number with a question. The second point I wish to refer to is the assertion in a foot-note on page 379, that I state "that the inflection (of the mandibular angle) is absent in European forms" (of Peratherium). I here referred to the species called Oxygomphius by Von Meyer, some of which are true marsupials, but others are, according to Schlosser, Talpidæ. If there be an error, it is that of Von Meyer.—*E. D. Cope.*

Geological News—General.—The "American Geologist" sends forth its first issue in January, 1888. It announced that it is to be a non-partisan publication, open to the properly-worded opinions of all, from the most powerful to the most obscure, and "committed to no theory whether of construction or obstruction." Its editors and proprietors are Profs. S. Calvin, of Iowa University; E. W. Claypole, of Buchtel College; A. E. Hicks, of Nebraska State University; N. H. Winchell, of Minnesota University; Dr. Persifor Frazer, of Philadelphia; Dr. A. Winchell, of Michigan University; and Mr. L. O. Ulrich, of the Geological Survey of Illinois.

Prof. Claypole utters (*American Geologist*) a most distinct warning to those who, merely because the wish is father to the thought, believe the supply of natural gas to be inexhaustible. Natural gas, oil, and salt-water are geologically connected, and, where the strata are arched upwards, usually collect in the order named. After a certain part of the gas has been drawn off the oil will rise, and lastly the brine. Many once productive oil-wells are now little more than brine wells, though their age is but twenty years.

Gregorio Stefanescu, chief of the Geological Survey of Roumania, has issued a geological atlas of that country in fourteen colored sheets. Diluvial and alluvial strata are largely developed, but crystalline rocks occupy the northern portion bordering on Transylvania.

Silurian.—Messrs. U. P. and J. F. James publish in the *Journal* of the Cincinnati Society of Natural History a revision of

the species of the Monticuliporoid corals of the Hudson River group. They admit two genera, Monticulipora and Ceramopora, the former with the sub-genera Dekayia, Constellaria and Fistulipora.

Devonian.—Prof. Calvin (*American Geologist*) describes *Streptindytes acervulariæ*, a new species and genus of tubicolar Annelida from strata of the Hamilton period, at Robert's Ferry, Iowa.

Carboniferous.—Dr. G. J. Hinde, in a paper read before the British Association at Manchester, brings evidence in support of the organic origin of the "chert" in the carboniferous limestone series of the British Isles. He believes that the Irish cherts at least are derived from the accumulation of the skeletal elements of the siliceous sponges.

Jurassic.—Prof. H. G. Seeley has shown, by superimposing a figure of the reputed clavicle upon the bone figured by Mr. Hulke as clavicle and interclavicle of Iguanodon (*Quart Journ. Geol. Soc.*, vol. xli. pl. xiv.) that the supposed sutures are fractures, and that the supposed interclavicle has no existence, except as an ossification posterior to the reputed clavicles. Prof. Seeley urges the analogy of these bones with the reputed pubes of crocodiles, and concludes that they are pre-pelvic.

Prof. Seeley concludes, from examination of fœtal Plesiosauri found in a phosphatized nodule of Lias, that the Plesiosaurus was viviparous, and that the species in question, probably *P. homospondylus*, produced many young at a birth.

Tertiary.—R. Lydekker (*Geol. Mag.*, July, 1887) states that all the so-called fossil Alligators of the Old World really belong to the genus Diplocynodon, and since the crocodiles (C. *palustris* and C. *sivalensis*) which approach nearest to this genus in the structure of the cranium and form of the maxillo-premaxillary suture on the palate are confined to India, it becomes interesting to know whether the existing alligator recently described from China, may not show signs of affinity with Diplocynodon.

Mr. Lydekker concludes that *Crocodilus champsoides* and C. *toliapicus*, from the London clay, are but the young and old individuals of a single species, for which the original name of C. *spenceri* Buckland, should be retained.

H. B. Geinitz identifies *Nautilus alabamensis* Morton, and *N. lingulatus* von Buch with *Nautilus ziczag* Sowerby, and places the form in the genus Aturia. The species is from the Tertiary of Alabama and Mississippi.

MINERALOGY AND PETROGRAPHY.[1]

PETROGRAPHICAL NEWS.—As the result of a recent trip through the southern extremity of Africa, E. Cohen[2] has succeeded in giving us quite a good deal of information regarding the Palæozoic formations of the Cape States. The pre-Devonian schists of the coast region have been treated in another place.[3] In the present paper the author confines himself to the various members of the Devonian and Carboniferous systems, and other formations overlying these. The most widespread rocks in this region are sandstones, graywackes and conglomerates. The Karroo formation (Triassic) Cohen divides into a lower, a middle and an upper series. The lower series comprises fragmental rocks with an occasional intercalated layer of an eruptive. The middle series is characterized by the number of layers of eruptives intruded between those of sedimentary rocks as well as by the number of dykes cutting across the latter. The eruptives, with a single exception, are plagioclase augite rocks. By far the larger proportion of these belong to the diabase family, many of them being olivine bearing. In the latter the pœcilitic structure is frequently well marked. The diabases, quartz diabases, proterobase and diabase porphyrites, of both the intercalated layers and the dykes, are regarded by Cohen (as the result of careful analyses) as mere phases of the same magma. The single exception to the prevailing plagioclase-augite eruptives mentioned above is in the case of a dyke-cutting olivine diabase. The material of this bears a strong resemblance to mica syenite. At the points where the diabase layers come in contact with the interstratified sandstone beds the latter have been subjected to considerable alteration. The unaltered rock is an ochre-yellow, fine grained sandstone, made up of quartz and colorless mica, besides a little iron hydroxide and earthy material. As it approaches the diabase it gradually loses all traces of its bedding planes, and in it is developed a green chloritic mineral, whose nature was not determined. Nearer to the eruptive the chloritic mineral increases in quantity, and in addition there is a development of biotite and a disappearance of the earthy material, which has probably gone to make up the biotite. In immediate contact with the diabase the sandstone has been entirely changed to a typical black hornfels. In it all the constituents have taken on a concretionary form. Analyses of the unaltered sandstone and of two typical altered phases teach that the change in the nature of the sedimentary rock is not due to any addition of diabase material. The dyke rocks produce but little alteration in the neighboring fragmentals. In

[1] Edited by Dr. W. S. Bayley, Madison, Wisconsin.
[2] Neues Jahrb. f. Min., etc., 1887, Beil. Bd. v. p. 195.
[3] Ib., 1874, p. 460.

one case, however, where a dyke cut sandstone, it was noticed that biotite plates were developed parallel to the sedimentary planes of the sandstone, while muscovite formed perpendicular to these planes. The remainder of the paper is devoted to a discussion of the upper members of the Karroo formation and to the Pleistocene deposits.

Another interesting paper is by K. Dalmer,[1] on the quartz trachyte of Campiglia, in Tuscany. The glassy variety of this quartz trachyte is a fine-grained gray rock, consisting of a glassy groundmass in which are porphyritic crystals of sanidine, quartz, biotite and cordierite, with occasional crystals of plagioclase. The quartz grains all possess a rounded outline in cross section, and are surrounded by a zone of glass. In addition to the minerals mentioned above there also occur in this variety prismatic crystals of some member of the scapolite group light red garnets, apatite and zircon. In a felsitic variety scapolite is lacking. In the neighborhood of the quartz grains the felsitic groundmass of the rock is replaced by a zone of glassy material. The cordierite is less fresh and it is in the glassy variety, and in many instances is entirely replaced by pinite. In a third variety, occurring in dykes, the groundmass is completely crystalline. These dykes of grano-porphyritic trachyte were regarded by Lotti[2] as quartz porphyries, and as apophyses of a so-called granite mass which occurs about fifteen hundred metres distant from them. This mass was likewise examined by Dalmer, who, while he finds it to possess the characteristics of a granite porphyry, believes that its present condition is due to the conditions under which it cooled, and that the three trachytes and the granite porphyry are all portions of the same magma, which, from the nature of its surroundings, gave rise to rocks which from their structure and mineralogical composition must be classified under different heads.

Professor C. R. Van Hise[3] communicates some additional[4] notes on the enlargement of hornblende and augite in fragmental and eruptive rocks. In the altered diabases of the Penokee-Gogebic Iron-Bearing Series crystals of uralitized augite are seen to have attached to them long acicular crystals of a very light green hornblende, which extend out from the uralite even into the surrounding decomposed feldspars. In other cases unaltered augite is surrounded by an almost continuous sheet of amphibole. In both cases the crystallographic axes of the two minerals coincide. Dr. G. H. Williams[5] describes the alteration of ilmenite into rutile, in altered diabase from the vicinity of Quinnesec, Mich. Irregularly-shaped pieces of ilmenite are surrounded by a network of little prismatic crystals of rutile.

[1] Neues Jahrb. f. Min., etc., 1887, ii., p. 206.
[2] Atti della Societa Toscana. Vol. vii.
[3] Amer. Jour. Sci., May, 1887, p. 385.
[4] American Naturalist, Dec. 1885, p. 1216.
[5] Neues Jahrb. f. Min., etc., 1887, ii., p. 263.

Alf. Gerhard[1] calls attention to the fact that most of the rocks described as soda-granites are really ordinary granites in which the proportion of sodium is little greater than is usually found in granites. The Ulfserud (Sweden) rock, however, appears really to contain a plagioclase approaching very near to albite in composition.

MINERALOGICAL NEWS.—*Dihydro-thenardite* is the name given by Markownikow[2] to a substance found in a thin colorless bed on the shore of Lake Gori, in the Gouvernement Tiflis, Russia. In composition it is a sodium sulphate differing from thenardite and mirabilite in appearance and its content of water. An analysis yielded 16.15 per cent. of water, corresponding to the formula $Na_2\ SO_4 + 2\ H_2\ O$. It crystallizes in the monoclinic system.—Laist and Norton[1] report the occurrence of a *new antimonide* from near Mytilene, Asia Minor. The new mineral resembles silver in color and lustre. It is massive and brittle. Its hardness is 4.-5. and its specific gravity 8.812. Upon analysis it yielded: Cu = 73.37 per cent., Sb = 26.86 per cent., corresponding to $Cu_{11}\ Sb_2$ (breithauptite = Ni Sb, dyscrasite = Ag_3 Sb – Ag_6 Sb.)— A *Barium manganite* from near Austinville, Wythe county, Virginia, according to Mr. Walker,[3] is of the following composition:

$Mn\ O_2$	$Mn\ O$	$Ba\ O$	$H_2\ O$	$Si\ O_2$	$(Fe_2\ O_3.\ Al_2\ O_3)$
68.86	7.51	14.42	5.08	1.98	2.23

It is found imbedded in psilomelane and ferruginous clay in the form of "radiating fine fibrous needles." Its color is brownish-black. Hardness = 1.5. Sp. Gr. = 3.27. It differs from varvicite ($Mn_4\ O_7 + H_2\ O$) and lepidophæite ($Cu\ Mn_6\ O_{12} + 9\ H_2\ O$) in containing Barium.[4] Its composition may be represented by the formula $Ba\ Mn_9\ O_{18} + {}_2O + 3\ H_2O$. In a letter to the *Neues Jahrbuch für Mineralogie* Darapsky[5] communicates the results of some analyses of certain Chilian zeolites and of a natural *amalgam* to which he ascribes the formula Ag_{39} Hg.— A black opaque mineral, associated with the tourmaline of Hamburg, N. J., and DeKalb, N. Y., Mr. Diller[6] thinks may be a fourth form of titanic oxide.

ROSENBUSCH'S "MASSIGE GESTEINE."—The second portion of Professor Rosenbusch's *Massige Gesteine*[7] fully sustains the good impression produced by the first part.[8] This concluding portion of

[1] Ib., 1887, ii., p. 267.
[2] Jour. d. russ. phys.-chem. Gesells. 1887 [I], p. 252; Ref. Ber. d. deutsch. chem. Gesells., 1887, p. 546
[3] Amer. Chem. Jour., x., Jan. 1886, p. 60.
[4] Ib., p. 41.
[5] Neues Jahrb. f. Min., etc., 1888, i., p. 65.
[6] Amer. Jour. Sci., Jan. 1888, p. 51.
[7] Mikroskopische Physiographie der Massigen Gesteine, 2 Abt. Stuttgart, 1887.
[8] American Naturalist, Feb. 1887, p. 172.

the great handbook of petrography embraces in its treatment the effusive rocks, which are divided into the palæovolcanic and the neovolcanic classes. Under the former are included the quartz-porphyries, the quartz-free porphyries and keratophyres, the porphyrites, the augite-porphyrites and melaphyres, and the picrite-porphyrites. We miss here the elæolite porphyrites, which have been relegated to the questionable group of dyke rocks, and the quartz-porphyrites, which have been merged into the porphyrite family. The melaphyres are now members of the augite-porphyrite family, and the keratophyres have found a home among the quartz-free porphyries. There are nowhere as sharp distinctions made between rocks of different mineralogical and chemical compositions as were found in the first edition of the *Massige Gesteine.* The classification has become somewhat more complicated than the old one, but at the same time it seems more reasonable in the light of recent investigations. Among the neovolcanic rocks we find the liparites and pantellerites, the trachytes and quartz-free pantellerites, the phonolites, the dacites, the andesites, the basalts, the tephrites and basanites, the leucite rocks, the nepheline rocks, the melilite rocks and the limburgites and augitites. We here also miss a few familiar groups. The augite andesites are classed with the andesites. The tephrites and basanites have been united into one family. The entire group of glassy rocks has been eliminated, and the individual members have been included among those families of the neovolcanic rocks with which they are genetically connected. The discovery of a triclinic potassium sodium feldspar by Förstner[1] in the sodium-rich liparites of the island Pantelleria has resulted in the separation of the old liparite family into two subfamilies—the liparites proper, containing sanidine, and the pantellerites containing anorthoclase as their principal feldspathic constituents. Each family among both the palæovolcanic and the neovolcanic effusives is composed of numerous species or varieties, each one of which is characterized by definite properties, as structure, composition, etc., which distinguish it from other members of the same family. But it would require too much space even to mention here the numerous members of the effusive rocks, and would serve but little purpose. The petrographer must study the *Massige Gesteine* if he would keep abreast of his science, and to no others would a detailed discussion of the many new suggestions contained in the book be interesting.

[1] Zeits. f. Kryst., 1877, i., p. 547, and 1883, viii., p. 125.

BOTANY.[1]

The Grass Flora of the Nebraska Plains.—The plains of Nebraska were originally covered in great part with various small grasses to which the common name of "Buffalo grass" was applied. The true Buffalo grass (*Buchloë dactyloides* Engelm.) formerly extended eastward to or nearly to the Missouri River, but now it is rare east of the 100th meridian. On the curious depression near the city of Lincoln, to which the general name of "Salt Marsh" has been given (although it is in no sense a marsh), small patches of Buffalo grass may still be found. It is a peculiar grass, and when one has once noticed a patch of it, he will at once be able to recognize it even at a distance. It invariably grows in patches, and in each patch scarcely anything else grows. It does not intermingle with other species but holds complete possession of the soil, forming a dense mat which chokes out all opposition.

Northwestward, up the Elkhorn Valley, Buffalo grass does not appear in any quantity until very nearly the 100th meridian is reached, although much of the land is still uncultivated. Going westward from Lincoln, small patches are to be seen in Clay county (98th meridian), and from this point it increases as one goes up the plain above the 2,000 ft. line. In the Loup valley, however, Buffalo grass is not abundant, while in the Republican it is very common. In the western portion of the State, from the Lodge Pole Creek on the south to the White River country on the north, it is still very abundant.

Gramma (*Bouteloua oligostachya* Torr.) is still found throughout the State, although it is by no means abundant in the eastern two-thirds. It is often called Buffalo grass, and from it a short hay is sometimes cut in the latter part of summer. Its relative, the Muskit or Mesquite grass (*Bouteloua racemosa* Lag.), has a still wider distribution, extending eastward into Iowa and Illinois, and westward across the plains.

In the far-west, above the altitude of 3,500 feet above the level of the sea, another of the grasses of the plains proper appears. It resembles Buffalo grass so closely in general appearance, that it may well bear the name of False Buffalo grass (*Munroa squarrosa* Torr.), although it belongs to an entirely distinct genus.

Upon the saline and alkaline soils Salt grass (*Distichlis maritima* Raf.) grows in abundance. I have seen it upon all parts of the great Nebraska plain.

The grasses which are most noticeable in nearly all portions of this region are the Blue Stems or, as they are sometimes called, the Blue Joints. The great *Andropogon provincialis* Lam. and its smaller relative *Andropogon scoparius* Michx. occur in company with *Chrysopogon nutans* Benth., the latter often called Bushy Blue

[1] Edited by Prof. Chas. E. Bessey, Lincoln, Neb.

Stem. Throughout all parts of the State they occur in company, and they are common and abundant in nearly every locality. However, in the eastern part of the region they grow taller, and are more inclined to entirely cover the ground. The first-named often attains a height of from six to eight feet. In the western part of the region *Andropogon saccharoides* Swz., a feathery topped species, occurs along with the preceding.

In the eastern counties Wheat grass (*Agropyrum glaucum* R. & S.) appears in little patches, which are plainly noticeable on account of their glaucous green color. As every botanist knows, this species bears a remarkable resemblance to Quack grass (*Agropyrum repens* Beauv.), but it is not as much inclined to spread by its underground rootstocks as its eastern relative. As we go westward this Wheat grass increases in abundance, and by the time we reach the altitude of 3,000 to 5,000 feet, it is one of the most valuable of the hay grasses, and is relied upon very largely for forage by the farmers and stock growers.

Two other grasses are very common upon the plains, viz., *Eatonia obtusata* Gr. and *Koeleria cristata* Pers. They occur everywhere upon the drier lands, and are emphatically Prairie grasses. With them we find very commonly *Sporobolus asper* Kth., a late-growing species, which remains standing all winter long, with leaves wrapped around its partly enclosed fruiting panicle.—*Charles E. Bessey.*

Solms-Laubach's Palæophytologie.—A few months ago this important work was brought out by Arthur Felix in Leipzig. Its scope may be indicated by the following summary of its contents: Thallophytes and Bryophytes receive 19 pages; Coniferæ, 33; Cycadeæ medulloseæ, 20; Cordaiteæ, 19; Ferns, 53; Lepidodendreæ, 48; Sigillarieæ, 23; Stigmaria, 32; Calamarieæ, 50; Sphenophylleæ, 13. Fifty or more pages are devoted to smaller groups, and to the discussion of genera of doubtful affinity. Forty-nine wood-cuts add materially to the value of the volume.

Botanical Work in New York.—The reception of two reports from the State botanist enables us to note the progress of systematic botany in New York. The statement of the work of the botanist for 1885, published in the Thirty-ninth Annual Report of the New York Museum of Natural History, 1886, includes descriptions of many new species of fungi, among which are seven species of Agaricus, one of Russula, two of Boletus. The New York species of the genera Pleurotus, Claudopus and Crepidotus are fully described.

In the Bulletin of the New York State Museum of Natural History, Vol. I., No. 2, which bears date of May, 1887, Mr. Peck describes fifty-four species of fungi, among which is an interesting

Morchella (*M. angusticeps*), which is apparently related to *M. conica* Pers. Descriptions of the New York species of the genera Paxillus, Cantharellus and Craterellus follow in the usual lucid style of the author. Measurements are give (unfortunately in fractions of an inch), and good notes as to habits and habitats.

The New York Pyrenomycetous fungi are listed according to Saccardo's nomenclature, and for convenience the former names are given in a parallel column. The Bulletin closes with a monograph of the New York species of Viscid Boleti. Fourteen species are carefully described, two of which (*B. subluteus* and *B. americanus*) are new to science. Two good plates accompany the Bulletin.—*Charles E. Bessey.*

The Death of Dr. Asa Gray.—On the 30th of January, Dr. Asa Gray, the venerable botanist, passed away, after an illness of two months. He was born in Oneida county, N. Y., November 18, 1810, and was consequently a little more than 77 years old when he died. Although spared to such an advanced age, with undiminished mental and bodily vigor, which enabled him to continue work into his 78th year, yet all the world of science will mourn his death, regretting that so great and kind a master should be taken away. A longer notice will appear later.

Botanical News.—The November-December number of *Hedwigia* contains a heliotype of the lamented Georg Winter, with a sketch of his life and labors. Dr. C. Sanio now assumes editorial control of *Hedwigia.*——The second number of *Annals of Botany* contains papers as follows, viz.: On Hydrothrix, a new genus of Pontederiaceæ, by Sir J. D. Hooker; On the obliteration of the Sieve-tubes in Laminariæ, by F. W. Oliver; Some words on the life-history of Lycopods, by Melchior Treub; On the modes of climbing in the genus Calamus, by F. O. Bower; On the limits of the use of the terms Caulome and Phyllome, by F. O. Bower; On the absorption of Water, and its relation to the constitution of the cell-wall, by J. R. Vaizey; On the use of certain plants as Alexipharmics, or Snake-bite Antidotes, by D. Morris; Notes on the genus Taphrina, by Benjamin L. Robinson. In addition there are several short notes, and a couple of book notices.——In the January *Journal of Botany*, James Britten takes up Professor E. L. Greene's discovery as to the nomenclature of Nymphæa (*Bull. Torr. Bot. Club*, Sept., 1887), and, after full discussion, makes out that hereafter our Nymphæaceæ must bear the following names: *Nymphœa advena* [Soland] Ait. (= *Nuphar advena* Ait.); *Nymphœa lutea* Linn. (= *Nuphar lutea* Smith.); *Nymphœa sagittifolia* Walt. (= *Nuphar sagittifolia* Pursh.); *Castalia pudica* Salisb. (= *Nymphœa odorata* Ait.) In other words, our Nuphars are hereafter to

be Nymphæas, and our Nymphæas hitherto are hereafter to be known as Castalias.——In the January *Gardener's Monthly* the suggestion is made that certain species of Cactus may become of value as fodder plants for domestic animals.——The January *Torrey Bulletin* contains Studies in Typhaceæ, by Thomas Morong; New and Little-known Grasses, by F. L. Scribner, and New Western Grasses, by George Vasey, besides other articles of interest. Professor James suggests the name Anthophyta for Phanerogamia —a very good name too.——The January *Botanical Gazette* contains a portrait of Dr. W. Pfeffer, of the Botanical Institute at Tübingen, with a sketch of the institute, illustrated with a plan and views. The index to Vol. XII., which accompanies this number, is a model among indexes. Certainly no reader of the last year's volume of the *Gazette* can complain, in Carlylean phrase, of its "indexlessness."

ZOOLOGY.

Functions of Invertebrate Otocysts.—Professor Yves Delage has been performing some experiments with a view of ascertaining the functions of the so-called ears of invertebrates. His results (*Archives de Zool. gén. et Expérim.* v. 1886) go to show that besides auditory capacities, they possess regulative faculties. When the octocysts were destroyed, the animal could not regulate its movements. This he shows is not due to the injury to the nerve, because the extirpation of the eyes did not produce disorder in the movements. His experiments were mostly upon Crustacea and Cephalopods.

Parasitic Rotifers.—The marine rotifers which are parasitic upon the curious Crustacean, Nebalia, are grouped in a family Seisonidæ and the species of these found in the Bay of Naples have recently been studied by Dr. L. Plate. He adds to the two genera before included (Seison and Saccobdella) a third, Paraseison, with four new species. In these the trochal discs have been reduced and may be represented by a few sensory setæ; the intestine terminates cæcally in either six; the reproductive glands are at the sides of or above the intestine; the tail has no sucking disk, but on the rounded extremity open the glands which serve to attach the ectoparasite to its host. The paper may be found in vol. vii. of the Naples *Mittheilungen*.

Mediterranean Synaptidæ.—Dr. R. Simon contributes to the Naples *Mittheilungen* (vii. p. 272, 1887) an account of the Mediterranean Synaptidæ, embracing the species *Synapta digitata*,

inhærens and *hispida*. These forms live on, not in the sand, in this not resembling our American *S. girardi*. There are some detailed accounts of the development of the calcareous plates of these as well as other Echinoderms. The author also describes a new species .of Chirodota (*C. venusta*), the first recorded from the Mediterranean.

BEDDARD ON EARTHWORMS.—The literature of the Lumbricidæ is rapidly assuming frightful proportions, so that none but the specialist can keep track of it. Mr. F. E. Beddard has recently added much to our knowledge of these forms. In the *Proceedings of the Zoological Society* (p. 154, 1887), he describes as new *Thamnodrilus gulielmi* from British Guiana. This genus resembles Anteus by the absence of dorsal pores, in having a single pair of spermathecæ in the seventh segment, and in position of the nephridial opening. In Thamnodrilus, however, the clitellum is much shorter, and the differentiation of the nephridia into three series is another character separating them. Later in the same volume (p. 544), he describes *Cryptodrilus fletcheri* (n.sp.) from Queensland. It possesses calciferous glands and in its nephridia it is much like *Microchæta* but their orifices vary in position from segment to segment. The seminal vescicles occur in segments 9 and 12, but not in the intermediate segments. A third paper (*Jour. Anat.* and *Physiol.* xxii, October, 1887) deals with the structure of the ovum in *Eudrilus sylvicola* from British Guiana. Here the ovary is enclosed with muscular walls, the muscles being continuous with those of the oviduct, and its interior is divided by trabeculæ into separate compartments, which are packed with ova and germinal cells. The history of these is traced, the most noticeable feature being the metamorphosis of some of the germinal cells to form an epithelial cap on one end of the ovum, while others degenerate and form a fibrous looking, and more or less fluid mass around the ovum. This degeneration may have nutritive functions, but Mr. Beddard suggests its analogy to the liquor folliculi of the mammalian ovary, a view which receives some support from the fact that the most nearly ripe ova are not always found nearest the entrance to the oviduct.

ZOOLOGICAL NOTES. — PROTOZOA.—Mr. H. B. Brady catalogues the recent species of Foraminifera, occurring in Great Britain in the December number of the *Journal of the Royal Microscopical Society*. The classification adopted is the same as that used in the Reports of the Voyage of the "Challenger." 267 species are enumerated, but one (*Trochammina robertsoni*) being regarded as new. The genus Haliphysema is regarded as a Foraminifera.

Dr. A. C. Stokes has recently described some more American Infusoria. In the *American Mon. Micros. Jour.* (p 141) he adds

to our fauna *Anthophysa stagnatilis Hexamita gyrans Chloromonas, Balanitizoon gyrans, Gerda vernalis Rhabdostyla vernalis, R. chæticola, Vorticella similis, V. vernalis, V. parasita, V. conica, Epistylis tincta,* and *Lagenophrys obovata.* In the Annals and Magazine of Natural History for August, 1887, he adds: *Onychodromopsis flexilis* (n. g. et sp.) *Tachysoma agile* (n. g. et sp.) *T. mirabile, T. parvistylum, Litonotus vermicularis, Loxodis magnus, Oxytricha biforia, O. hymenostoma, O. acuminata, O. caudata, Histrio inquietus, H. complanatus, Euplotes variabilis,* and *Chilodon vorax.* The last species feeds voraciously upon diatoms, some of which were actually longer than the infusorian.

Podarcella is the name given by Girard to a stalked Rhizopod allied to Arcella which occurs in the sea near Fécamp. The stalk is about one and one-half times as long as the lorica.

Worms.—The veteran, P. H. Gosse, describes twenty-four new British rotifers in the December number of the *Journal of the Royal Microscopical Society.* The specimens were from both fresh and salt water.

Those interested will find a valuable article on the anatomy and histology of the Aphroditaceæ, by Dr. E. Rhode, in the second volume of Schneider's *Zoologische Beiträge,* and one on the anatomy and histology of Eunice, by E. Jourdan, in the second volume (seventh series) of the *Annales des Sciences Naturelles.* Jourdan thinks he has founed the terminations of the nerves in the muscles; does not regard the "giant nerve fibre" of the ventral cord as nervous but rather as a supporting structure; describes the eye, found no glandular structures in the digestive tract, and describes the segmental organs, pedal glands, and pigment organs.

Crustacea.—It is usually believed that hermit-crabs appropriate dead shells for their homes but Mr. Lucas, in the *Transactions* of the Royal Society of Victoria, states that he witnessed a hermit attack a living Fasciolaria and little by little tear it in pieces, leaving the shell at last entirely empty. He also recalls the fact that, at least in tropical waters, the shells occupied by hermit-crabs have a fresh appearance, and he thinks that the crabs depend upon living shells rather than dead ones to form their homes. This certainly is not the case with the hermit-crabs in the colder Atlantic.

Leichmann has settled by means of sections the existence of two polar globules in the egg of *Asellus aquaticus.* His short paper may be found in number 263 of the *Zoologisches Anzeiger.*

The complete account of J. Nusbaum's investigations on the embryology of the opossum shrimp (Mysis) may be found in Lacaze Duthier's *Archiv. Zool. Expérim.* et *Générale*, vol. v. An abstract of his preliminary note was given in our pages last year (AM. NAT. xxi. p.).

ENTOMOLOGY.[1]

THE CAUSE OF THE GROWTH OF GALLS.—Herr M. W. Beyerinck has published a paper regarding the growth of the gall produced by a saw-fly, *Nematus capreæ*, on *Salix amygdalina*.[2] This article appears to be an important supplement to the observations of Adler, published some years ago. I have not seen the original paper by Beyerinck, and therefore quote from an abstract of it.[3]

"The production of the gall is undoubtedly due to the matter secreted by the poison-gland, which is, consequently, homologous with the poison of Hymenoptera aculeata; when the insect does not deposit an egg in the wound which it makes, the quantity of albuminous matter poured out by the vesicle is always less than when an egg is deposited; by careful observation it is possible to assure oneself that the size of the gall is always proportional to the size of the wound and the quantity of albuminoid matter introduced. By an experiment, in which the deposited egg was punctured by a fine needle, it was shown that the gall is due to the parent and not to the egg; but, of course, in such a case the gall remains small; neither the egg nor the larva are necessary for its production, though their presence exercises a certain influence on the regularity of the development."

"The author has endeavored to discover whether there is any persistent alteration in the protoplasm of the plant or not. If we suppose that the substance implicated in the substance of the gall is like the protoplasm of the plant, a living body able to grow indefinitely, or a substance which impresses a persistent modification on the protoplasm of the plant, we ought, if we should succeed in pushing the development of the gall as one of its parts beyond the stage at which it ordinarily stops, to find that the characters of the gall remain invariably the same. If, on the other hand, the gall-forming matter can not either grow itself nor form a new protoplasm capable of reproduction, we ought, under similar circumstances, to find the characters of the organ, whence the gall was developed,

[1] This department is edited by Prof. J. H. Comstock, Cornell University, Ithaca, N. Y., to whom communications, books for notice, etc., should be sent.

[2] Arch. Néerland. Sci. Exact. et Nat., XXI. (1887), pp. 475–92.

[3] Jour. Roy. Micr. Soc., 1887, p. 746

reappear. Experience has shown that the second is the condition which it obtains; a normal leaf modified by the gall-forming material grew into a normal leaf, and a root into a root.

"The galls of *Nematus* are possessed of extraordinary vitality; those of *N. capreæ* are found living long after the leaf is dead; *N. viminalis*, which is found on *Salix purpurea*, exhibits really remarkable properties; although abandoned by their inhabitants at the beginning of autumn and being surrounded by damp mould during the winter, they not only remain perfectly turgescent, but some of them are able, in the following summer, to begin a new life. Galls cannot be inherited. The specific material secreted by *Nematus capreæ*—and what is true of it is probably true of other forms—is an albuminoid substance which acts as an enzymatic body."

HOMOLOGUES OF ARACHNID APPENDAGES.[1]—Herr A. Lendl has studied the development of *Epeira diademata* with reference to the much-discussed problem of the homologies of the appendages. The general conclusions of his investigations are as follows: (a) The first pair of appendages represent antennæ; this is suggested by their origin, position, motion, jointing, and innervation from the supra-œsophageal ganglion. (b) The small tubercles under the upper lip resemble mandibles in their origin and in the connection of their ganglia with the œsophageal ring. They appear more like mandibles in the embryo than in the adult. (c) The homology of the next pair (maxillæ) is evident. (d) The prosternum is no lower lip, but a portion of the sternum supporting the mandibles. No lower lip is discoverable; but the first of the four pairs of legs represent the second pair of maxillæ in insects.—Jour. Roy. Micr. Soc., 1887, p. 747. Herr Wendl, however, does not seem to have improved matters, for all studies of the development of the Arachnid appendages go to show that the first pair cannot be homologous with the hexapod antennæ. The latter are primitively prestomial, the former post-oral.—*J. S. Kingsley.*

SYNOPSIS OF THE APHIDIDÆ OF MINNESOTA.—Bulletin No. 4 of the Geographical and Natural History Survey of Minnesota is a synopsis of the Aphididæ of that State, by Professor O. W. Oestlund, of the University of Minnesota. In this synopsis there is included a careful account of all the species of plant-life found in that State, together with notes on their habits. Many new species are described, and one new genus. The American species not yet found in Minnesota are indicated; and there is given a "List of North American plants with the species of Aphides known to attack them."

AN UNPUBLISHED ILLUSTRATED WORK ON NORTH AMERICAN LEPIDOPTERA.—Dr. Hagen calls attention[2] to "An unknown or for-

[1] Math. v. Naturw. Ber. aus Ungarn, IV. (1886), pp. 95–100.
[2] Entomologica Americana, vol. III, p. 173.

gotten illustration of North American Sphingidæ," a copy of which was presented to Harvard College by Mr. Wm. Calverley, of Barnegat, N. J., in October, 1887. The work consists of twenty-seven quarto plates of figures of Sphingidæ, and one of *Papilio calverleyi.* Dr. Hagen gives a careful description of the work, with a table of contents of the plates. As a copy was also given by Mr. Calverley to the Library of Cornell University, I am able to add a few facts of interest.

The lettering on the plates was done by hand. This accounts for a difference between the Harvard copy, as described by Hagen, and the one before me. In the former the names of the species figured on plate XV. are not indicated; in the Cornell copy they are given as follows: I. *Enyo camertus*, female; II. *Sphynx paphus*, male; III. *Macrosila hasdrubal*, female; IV. *Anceryx scyron*, female; V. *Calliomma lycastus*, female. In the Cornell copy all the plates are colored except plates XXII., XXIII. and XXIV. The plate illustrating *Papilio calverleyi* does not properly belong with the others; it is the same figure that was given with the original description of the species.[1]

The following statements are taken from a letter written by Mr. W. H. Edwards, Oct. 14, 1885, in reply to inquiries from the Cornell Library: "The work was never finished and never published. I gave away two or three copies of plain plates myself to friends; but have all the rest of my share here now. John W. Weidemeyer lived at Montclair, N. J., and did business in Cliff Street, New York. Stephen Calverley lived in Brooklyn. These two began the printing of plates of Sphinges. I joined them at second plate. I think twenty-eight plates were done; all drawn by Charles Waldo. Two plates were done in London, under supervision of the late Francis Walker, of the British Museum. I think four hundred copies were struck off. Weidemeyer intended to write text for these plates, but never did; and the work rested, and was never resumed."

EMBRYOLOGY.[2]

Hertwig's[3] Text-Book of Human and Vertebrate Embryology.—This very valuable hand-book of vertebrate embryology has just been completed by the publication of the second part, and, to those who know German, it will be a most welcome contribution to this very important subject.

Dr. Hertwig's little treatise is published in a convenient form, in

[1] Proc. Ent. Soc. Phila., 1864, pl. X.
[2] Edited by Prof. Jno. A. Ryder, Philadelphia.
[3] Lehrbuch der Entwickelungsgeschichte des Menschen und der Wirbelthiere. Von Dr. Oscar Hertwig. Octavo, pp. viii, 507. Gustav Fischer, Jena, 1887–1888.

large type, and with illustrations, which leave little to be desired. While the purpose of the work is the same as that of Kölliker's *Grundriss*, viz., for medical students, it presents certain admirable features not met with in the just-named classical and beautiful work of the venerable savant who holds the chair of anatomy in the University of Würzburg. The wonderful and accurate figures which adorn the pages of Kölliker's writings on embryology are no less attractive than the luminous style in which his expositions are couched. But in the *Grundriss* only two types are appealed to—viz., the Bird and Mammal, in order to unravel the intricacies of embryology as applied to the needs of the medical man.

With larger opportunities for study, and as the author of many classical contributions to the embryology of the lower types as well as through studies upon the maturation and fertilization of the egg in various types, Dr. Hertwig approaches his subject equipped with a range and profundity of knowledge not surpassed by any recent writer. His studies in experimental embryology—during which he, in association with his no less distinguished brother, Richard Hertwig, reached results of the most startling significance in causing multiple impregnation of a single ovum by previous immersion in dilute solutions of narcotics or anæsthetics—are still fresh in the minds of specialists. His no less interesting studies upon the phenomena of fertilization of the egg in echinoderms entitle him to rank amongst those pioneers of modern embryology who have given us a basis for a rational theory of heredity, founded, not upon abstract speculations, but upon carefully observed facts.

Through the observation of these facts by Hertwig and others it has been possible also to enunciate the doctrine of the continuity of germinal plasma and the laws of geotropy of the ovum; while his Cœlom theory, published in 1881, has already borne fruit in the admirable English treatise of Professor Haddon, which was noticed about a year since in this journal. This cœlom theory supplements that of the now universally accepted gastrula, and makes it possible to present the facts of embryology in such a manner as to render their comprehension easy and significant. While the protective coverings of ova—*i.e.*, the primary and secondary investments of the eggs of various types—have not been as fully discussed as they might have been, and the existence of a third or tertiary system of deciduous investments, derived from the segmenting ovum itself in the higher forms, has not been perhaps clearly recognized, on the whole the work commends itself as the most satisfactory manual which has yet appeared for those who have not the time to enter upon a special course of study in this branch of scientific discipline.

The author has succeeded, in the compass of two hundred pages, subdivided into thirteen chapters, in presenting in a novel and interesting manner what it is essential that the young naturalist or medical student should know of the sexual elements; the matura-

tion of the egg and the process of fertilization; the process of cleavage; the general principles of development; the development of the two primary germinal layers (Gastræa theory); the development of the middle layer (Cœlom theory); the history of the doctrine of germinal layers; the somites or segments; the blood and connective tissues (Mesenchyme theory); shaping of the external form; egg-envelopes of reptiles, birds, mammals and man. Each of the first thirteen chapters is epitomized at its conclusion in such a manner and in such logical sequence that these epitomes together form, perhaps, the most convenient synopsis of the present status of the principles of embryology.

The remaining three hundred pages of the book deal with organogeny, or the formation of the organs from the epiblast, hypoblast, mesoblast and mesenchyme. This portion is divided into four chapters, and in this respect differs in its method pretty widely from that followed by Haddon, who in his treatise includes a large group of structures, viz., lymphatic, blood-vascular and connective tissues under the subdivision of mesoblast. These are specially dealt with by Dr. Hertwig in a chapter on the mesenchyme.

The great advantage of this last method will be recognized by teachers of histology, who are thus furnished a means of more readily impressing upon the minds of pupils the true relations of that group of tissues and organs which form the intermediary vascular bonds and supporting structures for all the other organs. The genesis of the organs from the other primary layers is admirably illustrated with special reference to its bearings upon the anatomy of the adult human body, and is accomplished in a very satisfactory way, while enough data from comparative embryology are laid under contribution to give the reader a fair knowledge of the wide application of the principles laid down.

The chapter on the principles of development in the first part of the book and the concluding résumés of the last four chapters are admirable; and while it is probably premature to form an opinion as to the exact method of the origin of the segmental ducts, the conservative position of the author is probably to be commended. In this connection, further studies upon the germ-bands of the leeches and earthworms, upon which such remarkable results have been published by C. O. Whitman and E. B. Wilson, will probably give us important additional light.

The manual of Dr. Hertwig will doubtless fill a long-felt want; and it is to be hoped that it will be made accessible to the English-reading student through a translation by some capable person. As an aid in understanding many questions in pathology, physiology, the structure of the brain and mechanism of the nervous system, this little work will undoubtedly be found to be of great value in lightening the burden of the overtaxed medical student in his

efforts to master the intricacies of the anatomy and histology of the adult human body.—*J. A. Ryder.*

Mr. O. P. Hay's Observations on the Breeding-Habits of Amphiuma.—In the last number of this journal (page 95) an interesting account was given of how the *Amphiuma* coils herself about her eggs. The description of the eggs and embryos is so strikingly like that of *Ichthyophis glutinosus*, a limbless, worm-like salamander,—the development of which has been worked out by the Sarasin Brothers from material collected in Ceylon,—that it is very important to call attention to this resemblance and its probable significance.

Within about two years Professor Cope called attention to the fact that the structure of the skull of the Cæcilians and of *Amphiuma* showed that these two forms were related. It now turns out that the females of these two types have the same habit of coiling themselves about their ova, which in both cases are laid in strings, with constrictions separating them, somewhat like a string of beads, the individul ova in both being also of about the same size. This confirmation of Professor Cope's conclusions as to the taxonomic relations of these two types is a very interesting instance of the way in which embryological data may become available. It may also be noted that in some of the Cæcilians there are three plumose or feathered branchiæ arising close together, and evidently similar to those described by Mr. Hay in the young of *Amphiuma.*

It is to be hoped that that gentleman will be good enough to somewhere publish carefully-drawn figures of the egg-strings of *Amphiuma*, as well as of the embryos.—*J. A. Ryder.*

ARCHÆOLOGY AND ANTHROPOLOGY.[1]

The Anthropological Society of Washington has renewed and enlarged its sphere of usefulness. It has taken a new departure, in fact three new departures. It has elected a new president; it has become an incorporated society, and it has commenced the publication of a quarterly journal under the direction of an editorial committee. The name is *American Anthropologist*, the first number appearing January, 1888. The typography is in the highest order of the art. The article on the Chane-abal (four-language) tribe and dialect of Chiapas, by Dr. Brinton, Professor in the University of Pennsylvania, being done as to excite the admiration of all interested in the typographic art. The contents of the first number, in addition to the article just mentioned, are "The Law

[1] This department is edited by Thomas Wilson, Smithsonian Institution, Washington, D. C.

of Malthus," by Dr. Welling; "The Development of Timekeeping in Greece and Rome," by F. A. Seeley; "Anthropological Notes on the Human Hand," by Dr. Frank Baker. A future number will contain an article "From Barbarism to Civilization," by Major Powell, Director of the U. S. Bureau of Ethnology, a continuation of his history of man from savagery to barbarism.

Among the papers read before the society, of great value, and which we hope to see published ere long, was the prayer of a Navajo shaman, by Dr. Washington Matthews, U. S. A.; a linguistic map of North America, by Mr. H.W. Henshaw, of the U. S. Bureau of Ethnology, in which the author showed the existence, the condition and the relationship of the various Indian languages and dialects in all North America. The discussion of the Nephrite question, by Profs. Clarke and Merrill, was also interesting and valuable.

The New York Academy of Anthropology proposes to organize an International Congress of Anthropology in that city June 4–7; the project is a vast one, and, to be successful, will require the harmonious and energetic efforts of the anthropologists of the United States. The project is new in this country, but not in Europe. Anthropologic congresses have been there held for many years, and have been productive of much good in fixing a basis for the science and in harmonizing discordant opinions. Their importance has increased with each meeting, as has the number and intelligence of the attendants. The importance of one of these congresses held in the United States can scarcely be over-estimated. To make it a success and of practical value would require the co-operation of European anthropologists. Without it the proposed congress might be but slightly more important than the meetings of the section of anthropology in the Association for the Advancement of Science. If the co-operation and promise of attendance of the anthropologists of Europe has been secured, the success of the project is assured.

An attempt was made to hold such a congress at Athens, Greece, but it failed, owing to want of co-operation combined with the unsettled state of the country. But is not the time too short between now and June to correspond with the European anthropologists, distant and widely scattered as are their residences? Is it possible to secure their co-operation? Possibly it has already been done? They will take much interest in an international anthropological congress in America; many of them will gladly attend if the invitation is given within sufficient time, and they will feel grieved, and perhaps offended, at any arrangement which would leave them out.

The Centennial Celebration of the destruction of the Bastile takes place in the summer of next year (1889) in Paris. The Parisian

anthropologists will undoubtedly strive for the International Congress to be held in their city during that time. Their claim could be made with great show of right and would scarcely be ignored. It would be a source of regret if these two commendable projects should be made to interfere with, or nullify, the good that each might do.

CRIMINAL ANTHROPOLOGY.—The importance of the subject of Criminal Anthropology has not been properly appreciated in our country. I doubt if any branch of the social history of man can be studied with such practical benefit to the whole people.

Laws are still passed, and courts sit in its administration, as in olden time, the theory being to punish the criminal, not out of revenge, but for the prevention of crime. But in this principal object, the prevention of crime, the world has changed but little, and it is doubtful if it has improved any. There have surely been improvements in modern times in criminal jurisprudence, but they have been rather in matters of detail, pleading, practice, etc. Indictments are more simple and direct. The disqualifications of jurors are lessened, many matters of mere form have been brushed aside, all tending to the presentation of the truth to court and jury. The examination of the defendant as a witness is fast becoming a necessity. But with all this the science of criminal biology has received but slight attention from lawyers or law-makers. This, when done, must be done by anthropologists. The anthropologists of Europe are more interested in this work than are we of the United States. They have taken the initiative. An international convention met in Rome in the autumn of 1885, and devoted a week exclusively to criminal anthropology. In France the question of the *recidivists* presses hard upon the attention of the government. I saw a man stood up in the dock who had been then convicted of crime forty-two times. The Island of New Caledonia, in the South Pacific, serves as a prison for those who have been convicted of felony more than thrice. The Anthropological Society of Paris has taken up the subject and is now studying it seriously. By a law of France, all executed criminals, possibly only those of Paris, are delivered to this society, and in its Musee Broca are now to be seen all their articulated skeletons with a bit of cork filling the void made by the guillotine in the cervical vertebra. I feel that I can speak on this subject with more than ordinary authority. I have practised at the bar as a lawyer with reasonable success for twenty-five years, not so much, however, in the criminal branch. During my six years' consular life abroad there arose cases by which my attention was turned to the criminal system under the Code Napoleon. I was a member of the international congress for the reform and codification of the law of nations, and in my studies

of later years I have mixed, to a great extent, the sciences of law and anthropology, and I cannot too much exalt the investigation and study of criminal anthropology. But it should be practical as well as theoretical. The lawyer and legislator should be brought into communication with the anthropologist. Their co-operative labors would serve to elucidate the subject in a scientific as well as a practical manner, and would result in the lessening of crime and the general improvement of the body politic. A move in the right direction has been taken by the New York Academy of Anthropology at its meeting, January 3, 1888. The subject was divided into two sections, and the program of questions suggested for discussion was as follows:

CRIMINAL BIOLOGY.—1. What categories of criminals may we distinguish? and what are the fundamental characteristics, physical and psychical, which they display?

2. Is there a general bio-pathological constitution which predisposes its subject to the commission of crime? how does it originate, and what form does it assume?

3. What is the proper classification of human actions, based on the affections which give rise to them? What effect does the education of the moral nature have upon the passions, and, indirectly, upon crime?

4. Does the number of suicides stand in inverse ratio to the number of homicides?

5. Epilepsy and moral insanity in prisons and insane asylums.

6. Malingering among the insane.

7. The utility of a museum of criminal anthropology.

8. The influence of atmospheric and economic conditions of crime in America.

CRIMINAL SOCIOLOGY.—1. Should the theories of criminal anthropology be embodied in the revision of the penal code? and why?

2. The function of the medical expert in judicial procedure.

3. The best means for securing indemnity from crime.

4. The best means of combating relapses into crime (recidivism).

5. Crimes of a political character.

6. Ought students of criminal law to be admitted to penal establishments? and under what conditions?

The circular making the announcement, then continues:—

"We cannot too highly value the method of study of crime, which begins with the study of the criminal himself. It is impossible to evolve the criminal out of one's inner consciousness. Knowledge of his peculiarities is essential to any rational treatment of him, and this knowledge can only be gained by systematic, intelligent observation of his physical and mental habits, supple-

mented by an exhaustive analytical comparison of the facts observed, with a view to their right classification and interpretation."

Papers on the topics were to be read by Hon. A. C. Butts and Hon. Geo. H. Yeaman, of the New York Bar; Judge Calvin G. Pratt, of Supreme Court, Brooklyn, N. Y.; Foster L. Backus, Esq., of Brooklyn; Prof. J. J. Reese, of University of Pennsylvania; William J. Mann, Esq.; E. P. Thwing, M.D.; Prof. Moritz Benedict, of Vienna, and others.

The Bar Association of the District of Columbia has proposed an international or interstate law congress, to be held in the city of Washington, on the 22d of May, 1888, to which shall be invited representatives of all other bar associations, judges of courts, prosecuting officers, and lawyers whose eminence in their profession entitle them to that recognition. I do not know whether this will result in a permanent organization or not. But if so, I would suggest and strongly urge that it should have a section devoted to criminal anthropology; and that anthropologic societies and congresses should do the same. By this means professional lawyers who are amateurs of anthropology, and professional anthropologists who may be amateur lawyers, would have opportunities for the accomplishment of great good in their respective sciences.

MICROSCOPY.[1]

GERLACH'S EMBRYOSCOPE.[2]—The embryoscope, devised by Dr. Gerlach, supplies a great and long-felt desideratum in experimental embryology. It is a mechanism for closing hermetically, a circular opening, made with a trepan, in the shell of the hen's egg; and it serves the purpose of a window, through which the living embryo may be directly observed, and its development followed from day to day.

The instrument consists of two parts: 1. A *mounting-ring* (Aufsatzring) to be firmly cemented to the egg-shell. 2. A *key-piece* with glass front, which screws into the ring and closes it air-tight.

In the Cut. *A* represents the embryoscope in perspective, and *B*, in section. The metallic mounting-ring is 1¼ mm. thick, and has a lumen 2 cm. in diameter. The lower edge (*Ar*) is bevelled and saddle-shaped so as to fit the equatorial surface of the egg, while the upper edge is flat. From the outer surface of the ring, two square-cornered bars (*Z*) project in opposite directions. On its inner surface, a little above the lower edge, is a diaphragm (*Md*)

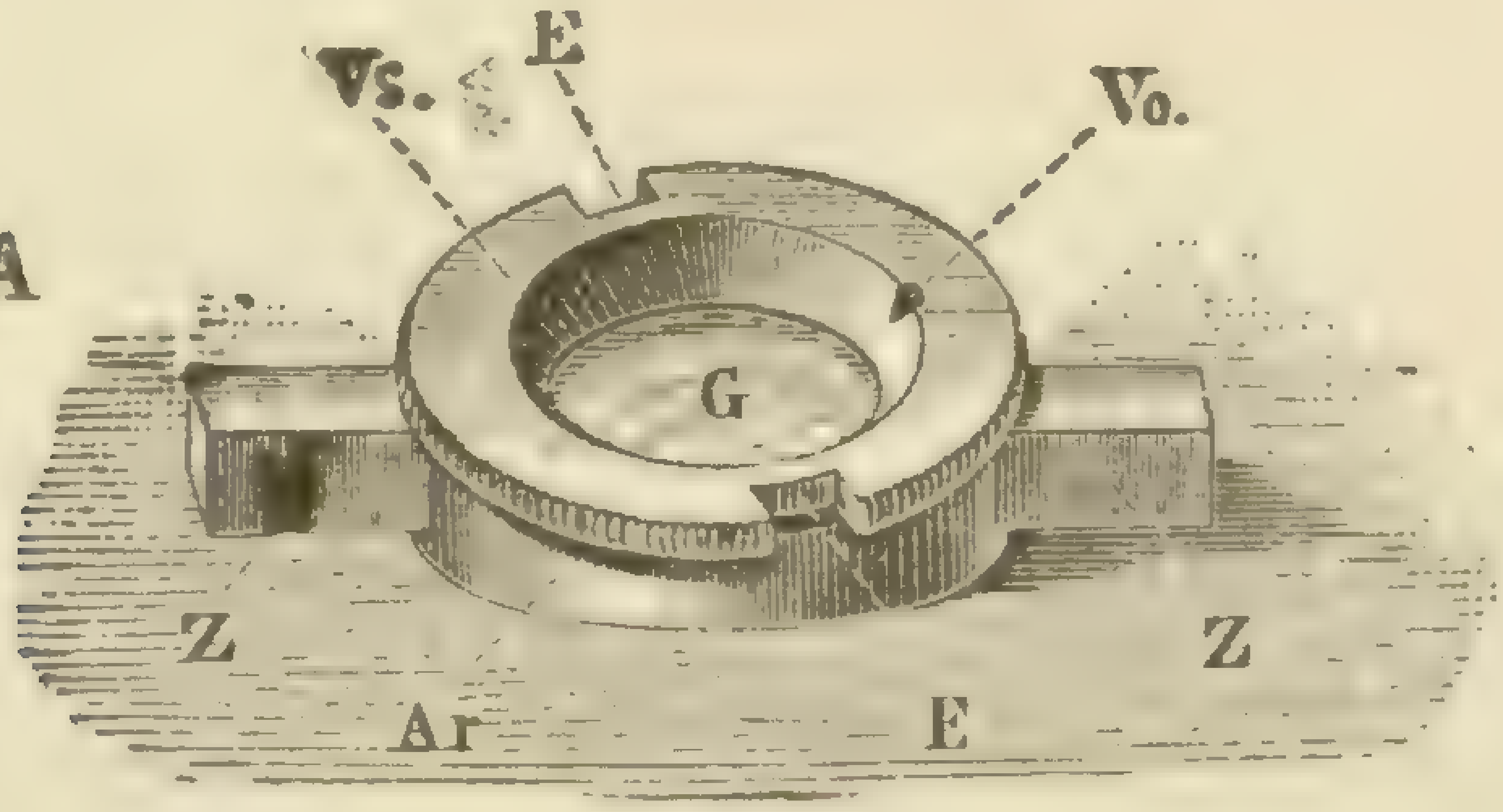
[1] Edited by C. O. Whitman, Milwaukee.
[2] Anatom. Anzeiger, II, Nos. 18 and 19, 1887, p. 583.

with an opening 13 mm. in diameter. Resting upon this diaphragm, and corresponding with it in size and shape, is a second diaphragm of thin wax-cloth (*Wd*), which serves as a packing-washer for the key-piece.

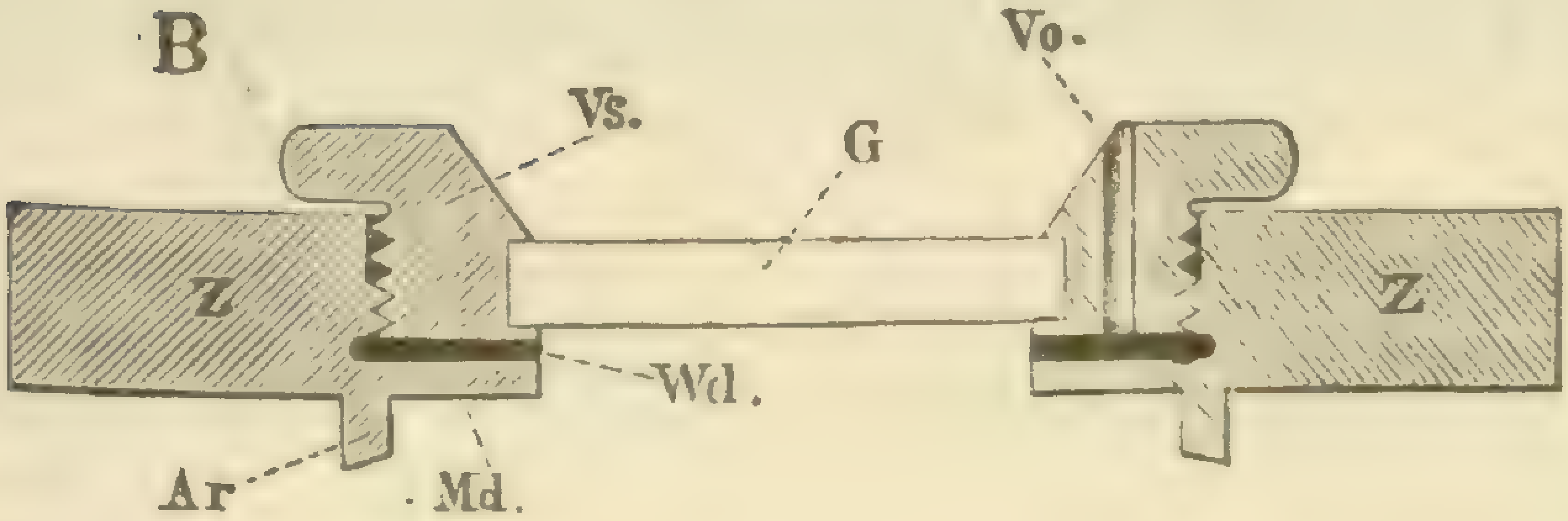
The key-piece of the embryoscope consists of a low, metallic cylinder, closed by a disk of glass (*G*), which represents the window that is to cover the artificial opening in the shell. The upper part of the cylinder expands peripherally to form a rim with a milled edge. This rim has two notches opposite each other, into which fit the arms of a small wrench, by the aid of which the key-piece can be tightly screwed down. There is also a short, narrow, vertical canal (Vo) or vent, the lower end of which must open in the middle of the key-piece ring.

The accessory apparatus required in the use of the embryoscope consists of (1) a *trepan*, (2) a *guide-ring* for the same, (3) a *metallic fork*, and (4) the *key or wrench* before mentioned.

A



B



The above-named pieces, together with a punch to cut wax-cloth diaphragms, and six embryoscopes, may be obtained from Reiniger, Gebbert, and Schall, Erlangen, for 36 marks, or from the Educational Supply Co., 6 Hamilton Place, Boston.

The trepan is a thin, metallic cylinder, 2 to 2½ cm. long, the lower end of which is toothed, while the upper part is fluted and serves as the handle. The diameter of the trepan is a trifle smaller than that of the opening of the diaphragm. The object of this is to leave a very narrow zone of shell, covered with shellac, inside the inner edge of the diaphragm.

The guide-ring for the trepan has the same construction as the

key-piece, except that it has no glass disk. It serves to steady as well as guide the trepan during the process of cutting.

The fork has two notches at the ends of its prongs, fitted to receive the two bars of the mounting-ring. When adjusted to the bars, the fork serves as a means of holding the embryoscope securely, while screwing or unscrewing the key-piece.

The wrench, the use of which has already been explained, is similar in construction to the wrench used for mathematical instruments.

The mounting-ring is fastened to the egg by means of a cement consisting of *two parts of wax* and *three parts of colophonium*. The cement is hard and brittle at the ordinary room-temperature, but becomes soft and kneadable when held in the hand for a few moments. After warming the mounting-ring over a gas or a spirit lamp, a roll of the softened cement is pressed into the space which must be completely filled between the lower face of the diaphragm and the lower edge of the ring. As soon as the ring becomes sufficiently cool, it is pressed firmly to the equatorial surface of the egg, and the excess of the still soft cement, which is thus forced outward and inward beneath the ring, should be removed before it becomes brittle, by the aid of a small, sharp-pointed blade. In order to avoid injuring the blastoderm, which might occur if the hot ring were fastened to the shell directly over it, it is best to fix the ring to the *side* rather than the top of the egg.

After the ring has been securely fixed and the superfluous cement removed, the exposed edges of the remaining cement, seen beneath the lower edge of the ring and the inner edge of the diaphragm, must be covered with a coat of an alcoholic solution of yellow shellac. This may be applied with a small brush, care being taken to cover the cement completely, and as little of the egg-shell as possible.

After the shellac has dried, a process which is completed in twelve to fourteen hours in the open air and in six hours in the incubator, the shell may be trepanned.

Antiseptic precautions are required in opening the egg. An oblong porcelain trough or glass dish is first filled with a 3% solution of carbolic acid, and in this are placed the instruments to be used in the operation: a *glass rod*, a medium-sized *brush*, small *shears*, *forceps*, the *trepan*, and the *guide-ring*. Before using, these instruments are dried with carbolized cotton, and after using returned to the dish of carbolic acid.

After washing the hands in dilute sublimate or carbolic acid, a perfectly fresh egg is painted with the three per cent. solution of carbolic acid, and then dried with carbolized cotton. The small end of the egg-shell is then cut out with the shears, and the thick white poured with the aid of the glass rod into a clean dish, leaving the yolk and the thinner white in the shell. The white is to be

used in screwing in the key-piece, and must therefore always be prepared beforehand.

After these preparations, the egg to which the mounting-ring has been cemented is disinfected in the manner above described, and placed in an egg-carrier with the ring uppermost. The inside of the ring is then brushed with carbolic acid, which is shaken out after one or two minutes and replaced by a ½% solution of common salt, which is also allowed to remain from one to two minutes, and then completely removed by means of carbolized cotton. The guide-ring is now screwed in, and the egg trepanned *from the side*, in order to avoid injuring the blastoderm. The egg is next placed with its opening upward, and the guide-ring removed. When the trepan is withdrawn, the excised piece of shell often comes with it, and sometimes the underlying shell-membrane. If this is not the case, the two pieces must be removed separately by the aid of the pincers. Care must, of course, be taken not to injure the blastoderm and the *zona pellucida*.

The thin white, which was left with the yolk in the shell, is allowed to flow over the glass rod upon the exposed blastoderm until the ring is filled, care being taken to avoid air bubbles. The wax-cloth diaphragm is next taken from the dish of carbolic acid, dried in blotting-paper, drawn through the thick white, and inserted in the ring in close contact with the metallic diaphragm; and then the key-piece, previously washed with carbolic acid and dried with carbolized cotton, is slowly screwed down. The superfluous white is thus slowly forced out through the vent (*Vo*), until the key-piece reaches the diaphragm and closes the vent. Finally, when the strength of the hand is no longer sufficient, the egg with its embryoscope is placed in the metallic fork, and the wrench applied until with this means it is no longer possible to turn the key-piece farther.

The process of trepanning and inserting the key-piece is somewhat more complicated in the case of eggs that have already been incubated, as the egg and the fluids employed must be kept warm. A water-bath is required, consisting of a low tin box, filled with water, and provided with covered apartments for the reception of the egg, the thin white, the carbolic acid, and the salt solution, which are in this way maintained at a proper temperature. In other respects, the mode of procedure is exactly the same as given above.

The key-piece may be removed as often as desired, provided the above precautions are taken each time in inserting it. If the key-piece is unscrewed by means of the fork and wrench, it must, of course, be washed in the warm carbolic acid, and the vent cleared by the introduction of a wire.

The egg must be placed in the incubator with the embryoscope

on one side. If it is placed upward, the respiration of the embryo is hindered. The embryoscope can be turned up at any moment, and kept upright for five minutes at a time without injury to the embryo.

With a little practice, the whole process of arming an egg with the embryoscope may be completed in from six to eight minutes.

The embryoscope is well adapted for purposes of class-demonstration, for investigating the growth of the various parts of the embryo, and the physiological processes during embryonic life, as the action of the heart, movements of the body, etc. It is indispensable to him who would study the effects of external agents upon the embryos of warm-blooded animals; and must be of great service where it is required to determine the precise stage of development before removing the embryo from the egg. It has been found useful in studying the formation of double embryos. Fenestrated eggs have been successfully incubated up to the thirteenth day, and it is probable that under favorable conditions the embryos of such eggs would reach maturity.

On the fifth day, it is still easy to bring the embryos under the window. On the sixth and seventh days, it is more difficult. At this period the change in the position of the embryo, which requires from five to ten minutes, should take place in the incubator.

After the eighth day, the embryo cannot be brought under the window. If it be necessary to determine whether such an egg or an older one still lives, we have only to leave the egg for several hours in the incubator with the window directed upwards a little, after which, by strong reflected light, one may readily see the blood circulating through the channels of the vascular area.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Academy of Natural Sciences of Philadelphia.—Sept. 20, 1887.—Mr. G. H. Parker gave an historical sketch of investigations upon the eyes of arthropods. Grenacher's theory of the hypodermal origin of the retina, developed by involution, has been borne out by later studies. From a study of the nerve distribution, the speaker believed the three-layered eye to be evolved from that with one layer.

Mr. Meehan stated that in Mesembryanthemum and similar plants, the glands of which develop in inverse proportion to the roots, chemical analysis sometimes determines the presence of more nitrogen than can be obtained from the soil. It was suggested that the glands absorbed the gas from the atmosphere.

Mr. H. T. Cresson exhibited specimens of prehistoric implements collected from beds surrounding what had probably been pile dwellings on the mud flats of the Delaware, near Naaman's Creek.

Professor Heilprin described the finding of the remains of a mastodon near Pemberton, N. J.

Oct. 18, 1887.—Dr. H. C. McCook gave an account of an American tarantula which must have been at least seven years old at death, and stated that a queen of the fuscous ant, in the possession of Sir J. Lubbock, died at the age of thirteen years.

Dr. Leidy described a collection of fossil bones from Archer, Fla., and characterized *Hippotherium plicatile*, from teeth and ankle bones, as a species of horse new to science.

Professor Ryder described a ring-like prolongation of the placenta in embryo mice and rats, as indicating the descent of these animals from lower types on which the placenta was zonary.

Oct. 25, 1887.—Professor J. A. Ryder stated his conviction that the organ in the head of fishes, supposed by Wiedersheim to be the homologue of the pineal gland, was really a portion of the lateral line system, and thus derived from the skin.

Mr. Woolman described the deposits pierced by an artesian well, 1,100 feet deep, at Atlantic City. Thirty-one species, including three sharks and a crocodile, were the fossil harvest.

Professor Heilprin stated that *Perna maxillata* found in the above well at a depth of about 800 feet, in dark clay, indicated the base of the miocene, while the Turritella found above indicated the middle miocene. The speaker and his class had recently collected several species new to the miocene fauna of New Jersey, including three new to science.

Dr. Kœnig described a new variety of unisilicate of manganese, and proposed for it the name "Bementite."

Dr. Leidy stated his belief, founded on examination of numerous examples, that the brown hydra of North America is identical with that of Europe; and Professor Ryder stated that the marine parasitic infusoria of the American coast were the same as those of Europe.

Dr. Cheston Morris described certain Dorsetshire sheep which seemed to be intermediate between the ordinary sheep and the goat.

Nov. 1, 1887.—Dr. H. C. McCook described the habits of *Formica rufa*, their mounds, their straight roads, etc. *Atta fervens*, a Texan ant, constructs straight underground trails, sometimes for a length of 448 feet.

Dr. Dolley spoke of the native cotton of Harbor Island, one of the Bahamas. It is of a reddish buff tint, and is not attacked by the cotton worm.

Professor Heilprin exhibited the mastodon remains found at Pemberton, N. J.

Nov. 15, 1887.—Professor Ryder described certain improvements in preparing tissues for the microscope. Soaking in celloidin and then in chloroform enabled the most fragile structures to be manipulated.

Nov. 22, 1887.—Dr. H. C. McCook described *Cyrtophora bifurca*, a new orb-weaving spider from Florida.

Dec. 6, 1887.—Mr. Meehan called attention to the prolific growth of interaxial tubers obtained from *Dioscorea eburnea*, a Chinese plant.

Dec. 13, 1887.—Mr. W. H. Dall mentioned the finding of the parasite *Leucochloridum paradoxum* in a Western species of Succinea.

Jan. 24, 1888.—Professor W. P. Wilson stated that the apparatus for catching and assimilating insect food is much more efficient in *Sarracenia variolaris* than in *C. purpurea*.

Dr. Horn exhibited a collection of May beetles, comprehending 79 out of the 81 species known north of Mexico.

Professor J. A. Ryder stated that the manner of cleavage of the yolk in the eggs of lampreys and Batrachia differs from that which obtains in osseous fishes, birds and reptiles.

Biological Society of Washington, 117th Regular Meeting.—Dec. 17, 1887.— The following communications were presented—Mr. C. L. Hopkins, "Notes Relative to the Sense of Smell in Buzzards;" Dr. Cooper Curtice, "The Timber Line of Pike's Peak;" Mr. Charles D. Walcott, exhibited a section of a fossil Endoceras over eight feet in length, with remarks on the same; Dr. Leonhard Stejneger, "On the Extinction of the Great Northern Sea Cow;" Dr. C. Hart Merriam, "Description of a New Mouse from the Great Plains."

118th Regular Meeting.— Dec. 31st, 1887.—The following communications were read:—Mr. W. J. McGee, "The Overlapping Habitats of *Sturnella magna*, and *S. neglecta* in Iowa;" Dr. C. Hart Merriam, "Description of a new Field Mouse from Western Dakota;" Mr. W. B. Barrows, "The Shape of the Bill in Snail-eating Birds;" Mr. H. Justin Roddy, "Feeding Habits of some Young Raptores."

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MORPHOLOGY OF THE LEGS OF HYMENOPTEROUS INSECTS.[1]

BY PROF. A. J. COOK, AGRICULTURAL COLLEGE, MICHIGAN.

According to our modern philosophy regarding the origin and development of animal organs and organisms, we should look at such organs as are much used in the animal economy to find extremes in modification. Thus among mammals the teeth are

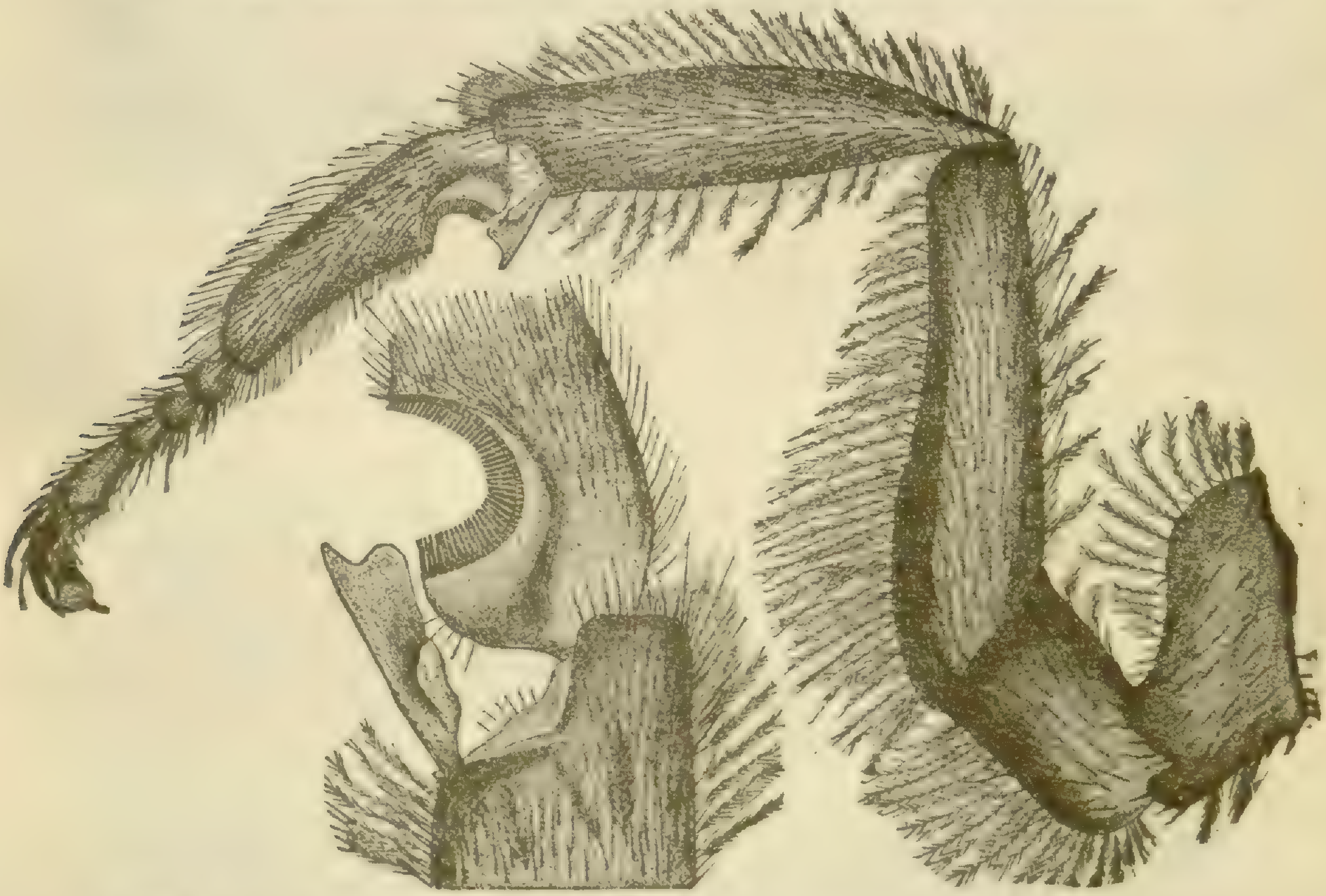

Fig. 1.

[1] This paper was read before American Association for Advancement of Science, in August, 1887, at N. Y. meeting.

most modified and very important in systematic mammalogy. For like reason the ornithologist looks to bill and feet in his study of families and genera. With the laws of variation and adaptation before us, we should expect to find modification carried to extremes among Hymenopterous insects. The life functions of these insects are so wonderful and varied that a maximum differentation of organs and structure is required for their execution. The chief tools used by these Hymenopterons are the legs and mouth organs, and it is to the former that I invite attention.

Let us consider the anterior or prothoracic legs of the honey-bee. We first notice (Fig. 1) a strong and interesting modification in the basal tarsus and tibial spur, which modification is known as the "antenna cleaner." At the base of the first tarsal joint and in the angle between it and the tibia is a short, hollow semi-cylinder. The concave surface of this cavity is smooth except at the outside margin, where there are from seventy-eight to ninety projecting hairs, which under the microscope remind one of the villi of the small intestines of mammals. These teeth, like hairs, projecting as a fringe, form a most delicate brush. The tibial spur is so modified as to resemble a very short handled razor, the blade of which is for a wide space facing the tarsus, a most delicate membrane, and this blade forms a sort of lid to the cavity just described. When the leg is straight this lid barely reaches the cavity; but when the first tarsus is flexed upon the tibia it serves as a cover to the cavity and really closes it.

The peculiar structure is found in both sexes and in the abortive females or workers of social bees, in all other bees, in all wasps so far as I have examined, in the Mutillidæ, Formicidæ in ants, in all the families of parasitic Hymenoptera except the Chalcids, while in the Cynips, Cynipidæ, Saw flies, Tenthredinidæ, and horn-tails, Uroceridæ, we find it nearly or quite absent.

We find the "antenna cleaner" in all species of bees—Apidæ—even in the curious species like the male of Megachile (Fig. 2), where the whole anterior leg is remarkably modified. In the bumble-bees species of the genus Bombus we find the antenna cleaner almost

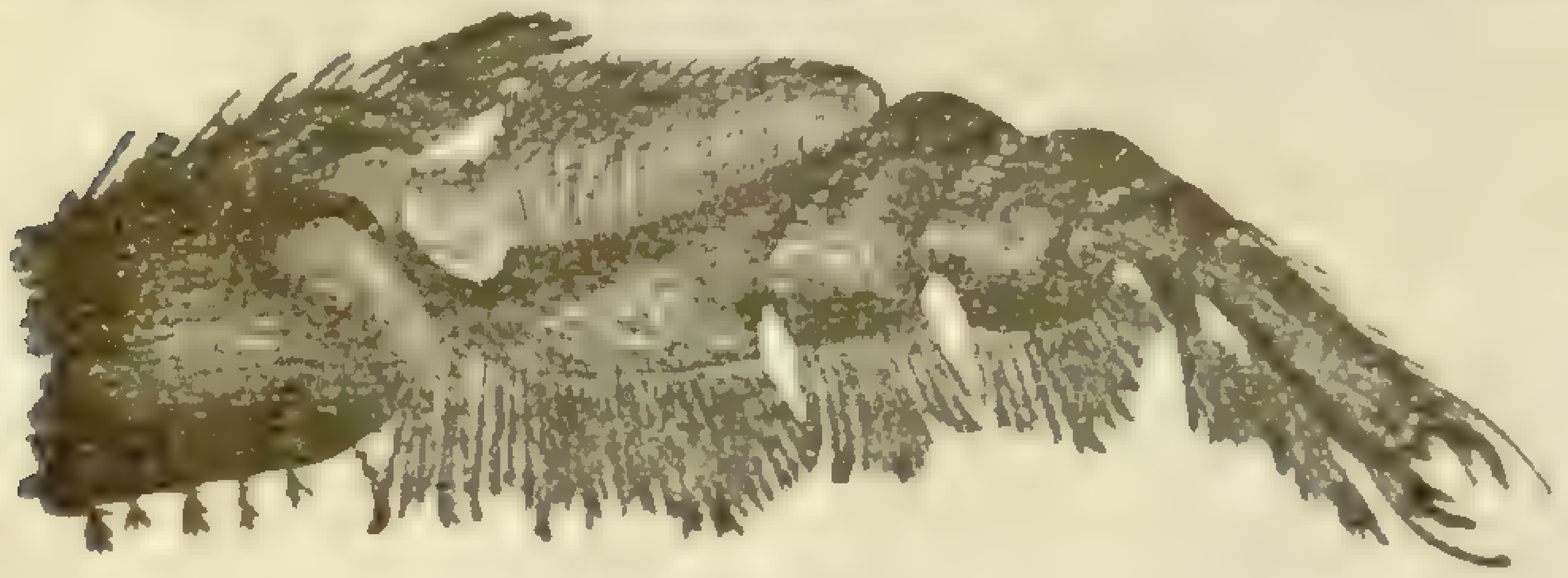

Fig. 2.

exactly like that of the honey-bee, except the part which I have termed the blade, in the modified tibial spur has its back more extended, and the whole back of the blade and the extended point thickly set with short spines, reminding one of the serrations on the antennæ of many beetles like the Buprestids. In the carpenter-bees—Xylocopa—there is no variation from the type of the Bombus except the serrated margin of the blade is still more marked. In the female of the tailor-bees—Megachile—the extended point and serrations are both absent, and we have again the form of this organ in the honey-bee. The number of the teeth in the cavity however, is less, there being from forty-five to fifty. In Osmia and Andrena (Fig. 3), the arrangement is much as in the Xylocopa; in Nomada the serrations are less spinous and more scattered, while in the beautiful species of Angochlora the cavity is quite shallow, the blade of the spur narrow, and the spines on the back and point of the blade slim and hair like.

Fig. 3.

In the several families of wasps we find this pollen cleaner, well developed, and in some cases quite modified from the same in bees. In the paper-making wasps—Vespidæ—it is much as in the lowest bees—Nomada and Angochlora. The cavity is more shallow than in the honey-bee, the membranous portion of the blade is quite narrow, and the appendages on the point of the blade are hair-like, though those near the base remind one of saw teeth.

In sand-wasps—Bembecidæ—this organ is much as seen in bees and paper-making wasps; though the point of the blade is very long, and the back and point both thickly set with fine hairs.

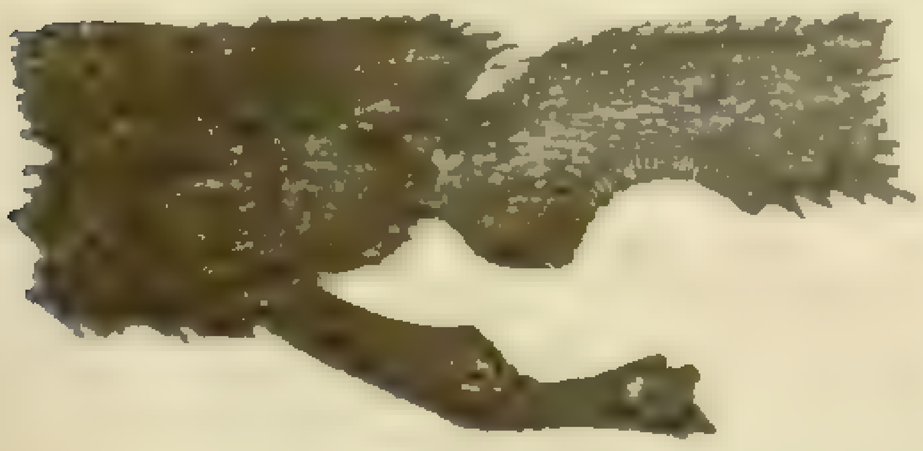
Fig. 4.

In all species of mud wasps, belonging to the family Sphegidæ (Fig 4) we find an interesting modification in the spur. Here the membranous portion of the blade is nearly obsolete, while its inner margin is concave and fringed with a toothed brush much as seen in the cavity, though the teeth are shorter. The end of the blade is blunt, and bears from five to eight heavy appendages, which, when magnified, look like so many fingers.

In the beautiful mud wasps of the family Pompilidæ, this apparatus is much as in the Sphegidæ, except that the cavity is more shallow. The fringe on the spur is peculiarly fine and beautiful. The spur is pointed, the point being flat and margined on both sides with spines.

In the Mutillidæ this organ is specially well shown. The type is that of the bees and Vespidæ, as the blade is membranous and without the fringe. The back and both sides of the point, however, are covered with a row of spinous hairs.

In the ants—Formicidæ—(Fig 5) the cavity is shallow and the fringe well marked in the cavity and on the spur where it is double, and while this brush is beautiful, it is not widely different from the hairs on the point of the blade, and on the remaining part of the basal tarsus.

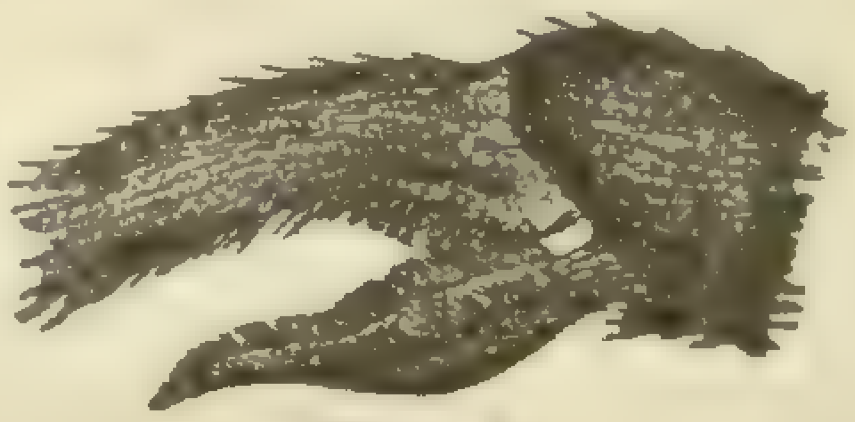

FIG. 5.

FIG. 6.

In Ichneumonidæ (Fig. 6), and Braconidæ we find this antenna cleaner, less developed, though still present. The cavity is hardly more than an inclined plane, the rise at the distal end being very slight. The spur is marked by a distinct concavity, and the fringe is present in the cavity and on the spur, though the brush in case is made up of coarser hairs than are found in bees or wasps.

In the species of Chrysidæ we find this apparatus more perfect than in the Ichneumonidæ. The cavity is deeper, the spur concave, and both show the comb or fringe well marked. The species of this family are unique in that the concave spur is fringed to the very point of the blade.

In the minute Proctotrupidæ the antenna cleaner is even less developed than in the Ichneumon flies. The cavity is almost wholly obsolete, the spur is only slightly concave, and the hairs forming the brush are hardly different from the other hairs of the leg. In the Chalcid flies—Chalcididæ—the cavity is wholly absent, and the only suggestion of this apparatus is in the slightly curved spur. The brush is also obsolete. The same is hardly less true of the gall-

flies—Cynipidæ. In the saw-flies—Tenthredinidæ—(Fig. 7), there is no hint of the cavity on the first tarsus; but a slight concavity of the spur, with the membrane just visible, still suggests the "pollen cleaner." In the horn-tails—Uroceridæ—the only reminder we have of the antenna cleaner is in the slightly curved spur. The membranous part of the blade is wholly wanting.

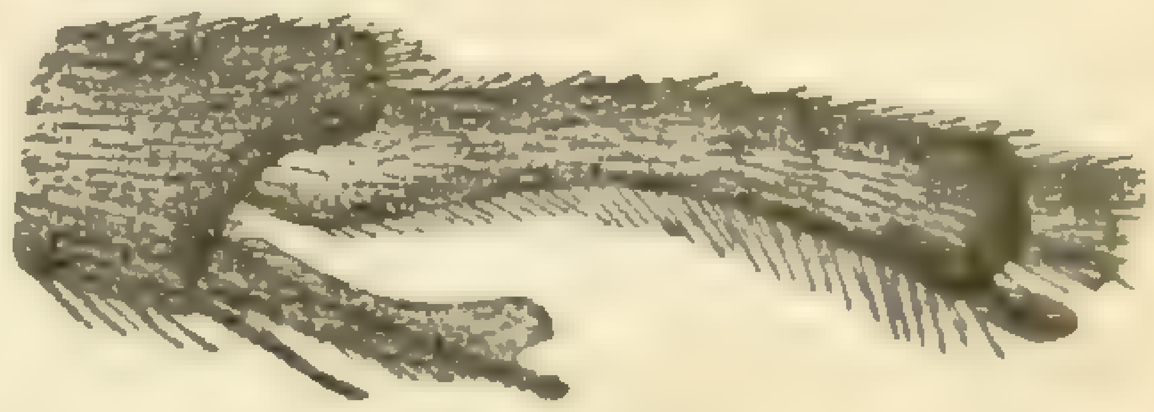

Fig. 7.

In the study of this apparatus I have been very much interested to note how persistent is its type within each family. I have carefully examined very numerous specimens, and I think we could, from the study of this organ alone, arrange the species of Hymenoptera, with very few exceptions, in their respective families. The same is also true in many cases of genera. We shall not wonder at this as we come to study the function of the organ and note its great importance.

No one who has studied bees closely can doubt for a moment the functional importance of the antennæ. As touch organs, they are most delicate and wonderful. The work of the hive bee is largely performed in total darkness. Yet very intricate operations are carried on with unerring exactness. This is only possible through the aid of those very sensitive tactile organs—the antennæ. There is hardly less doubt that the antennæ are the scent organs of insects. And with Hymenopterous insects, especially of the higher families, the sense of smell is of exceeding importance. It has been thought also that the antennæ serve as organs of hearing. This, however, is probably not true. We see then that it is of the highest importance that these organs be kept free from all dust. But the very habits of most Hymenopterous insects, visiting, as they do, flowers laden with pollen, as do all except the lowest families, or digging in the mud and dust, as do many bees and wasps, tend to soil the antennæ. And it is no more necessary for the microscopist to brush the lenses of his objectives than for the bee or wasp to dust its antennæ.

That the function of the apparatus just described is to brush or free from dust the antennæ is easily proved by experiment. We have only to imprison a bee or wasp on the window pane of our room, and quietly dust its antennæ with lime or flour, when we will see it pass an anterior leg forward, draw an antennæ through the

cleaner, after which the bee will pass the fore legs, now foul with dust, between the brushes formed by the soft hairy inner faces of the basal tarsi of the middle legs. This will be repeated several times, when upon examination the antennæ will be found entirely freed from the troublesome dust. In case of the wasp, as *Polistus annularis*, the antennæ are cleaned the same as just described except that the leg or antenn cleaner is cleanedæ by passing it between the jaws instead of between the middle legs. As we are sure of the function of this beautiful apparatus we do not need to refer to the wonderful correspondence in size of the cavity in each separate case, with the antennæ of the same insect, which would be added proof if such were needed as to its function. I will also state that I believe I have found an antennæ cleaner in some beetles, especially carabids. In these cases the cavity and lid are both on the tibia a little distance towards the body from its farther end.

In the honey-bee on the outer end of the tibia, just opposite the antennæ cleaner (Fig. 1), is a small brush. This has been regarded by some as a cleaner of the antennæ cleaners ; but we have seen that the latter organs are cleaned in another way. I have never seen these brushes used to clean the cavities, though I have observed closely. The fact that other bees, wasps, ants, etc., have no such brush makes me doubt such function.

The branching, fluffy hairs which cover the upper part of the fore leg (Fig. 1) of the worker honey-bee are like the same in other legs of the same insect, of use in gathering the pollen. From these hairs the pollen is combed off and transported to the pollen baskets.

Opposite the side of the basal tarsus which contains the cavity of the antennæ cleaner of the bee (Fig. 1), is a comb formed of quite stiff hairs. This is used to free the hairy compound eyes of the bees of dust, pollen, etc., and also to comb the pollen off the lighter hairs. The former function may be observed by closer observation, as the bee is seen to wipe its pollen-begrimmed eyes, much as the common house fly is observed to rub its eyes, face and antennæ.

The middle legs of bees are covered with the compound hairs to the end of the tibia where a prominent tibial spur (Fig. 8) is seen, but no more prominent in the honey-bee than in other bees and in wasps. Indeed it is even larger in drones than in the

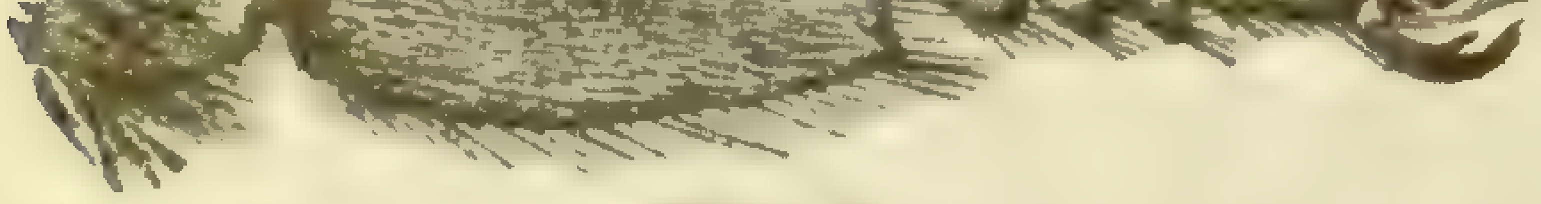

Fig. 8.

worker bees. It has been claimed that this is the lever with which the bee pries off the pollen mass into the cell; but the fact that these are no more prominent than in other insects where there is no such function to be performed, and the fact that the stiff hairs which point outward at the ends of these and all the legs are better fitted for this work, gives reason to question the accuracy of this view. On the inside of the first tarsal joint of the middle legs (Fig. 8) is a fine brush thickly set with hairs, which, as we have already seen, is used to clean the antennæ cleaner, and, as I often noticed large masses of pollen adhering to this brush, I am led to the conclusion that these are hands or claspers that aid to bear the pollen to the baskets on the posterior legs. The lower or outer hairs of this brush are spine-like and doubtless aid as already suggested in pushing the loads of pollen from the legs into the cells of the comb.

Fig. 9.

Upon the first three joints of the posterior legs, the coxa, trochanter and femur (Fig. 10) the soft, compound, polen gathering hairs are well shown. In the honey bee the tibia and first tarsus ars wonderfully developed. On the outside (Fig. 9) are cavities for holding the pollen. These shallow cavities, one in each of the joints, are bordered with course hairs, which serve as so many stakes to aid in holding the large pollen masses which the bee is often seen carrying to the hive. Opposite the concavity of the tarsal joint (Fig. 10) on the inside are to be seen nine or ten rows of beautiful yellow hairs, which form as many combs or brushes, which serve to collect and transport the pollen from different parts of the bee to the pollen baskets. If a bee is captured while collecting pollen,

these beautiful brushes will always be found with more or less pollen adhering to them. Of course the combs of one leg are used to fill the pollen basket of the opposite legs. As before stated, this work is in part performed by a similar but less perfect arrangement on the corresponding portion of the middle legs.

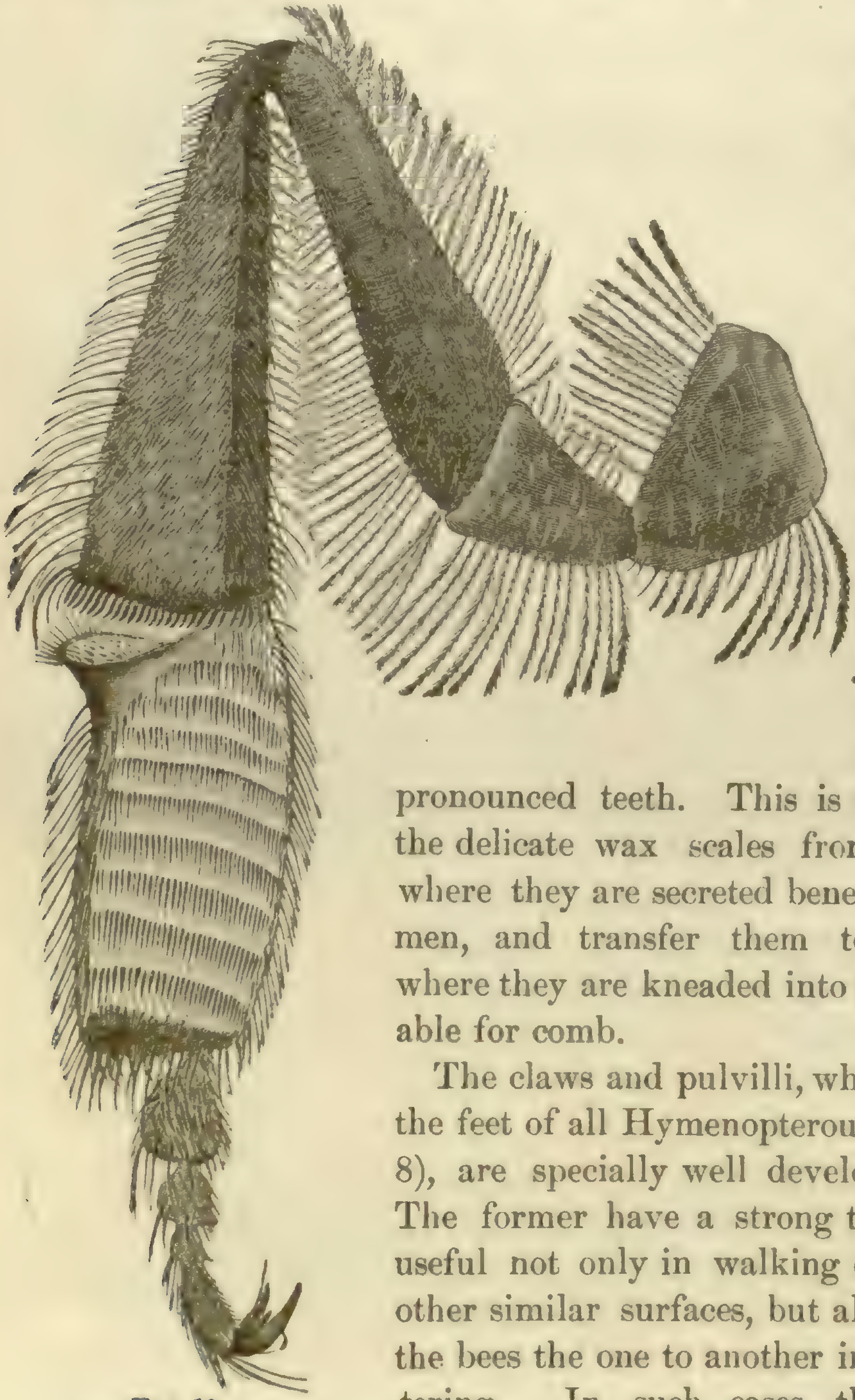

FIG. 10.

Between the tibia and first tarsus of the posterior legs of the honey-bee (Figs. 9 and 10) is a very curious joint, reminding one of a steel trap or the jaws of an animal, the tibial or inner jaw of which is well covered with quite pronounced teeth. This is used to grasp the delicate wax scales from the pockets where they are secreted beneath the abdomen, and transfer them to the mouth where they are kneaded into material suitable for comb.

The claws and pulvilli, which terminate the feet of all Hymenopterous insects (Fig. 8), are specially well developed in bees. The former have a strong tooth and are useful not only in walking on wood and other similar surfaces, but also in holding the bees the one to another in case of clustering. In such cases the uppermost have to sustain hundreds of their fellows, and this often for hours. There are few better examples in the whole animal kingdom of what may be accomplished by mere muscle.

The pulvilli are situated between the claws. They are large and glandular, and by secreting a viscid adhesive material enable a bee to walk up a smooth surface like that of glass. We thus understand why a bee fails in its attempt to walk up a moistened or powdered glass surface. When a bee walks on wood the pulvilli are turned back, when on glass the claws are similarly made to change their position.

DIRECTIVE COLORATION IN ANIMALS.

BY J. E. TODD.

MUCH has been written by Wallace, Darwin and others concerning the protective effects of coloration in animals, and this adaptation perhaps accounts for most of the chromatic characteristics of animals. Darwin has also shown how many may be accounted for by sexual selection, and Wallace has referred many of those, still remaining unexplained, to the play of color-producing forces uncontrolled by natural selection.

So far as the author is aware, however, there has been no distinct enunciation of the principle sketched in the following pages. The nearest approach to it is a remark of Darwin in regard to the rabbit's white tail—that it might serve as guide to the young in following the old ones to the burrow; and another—that the stripes of the zebra may be of use to stragglers in recognizing their fellows at a distance. (Vide AM. NAT., 1877.)

Wallace approves the suggestion, and, from some notes of his recent Baltimore lectures, it may be inferred that he has carried the principle further. But in their published writings both these eminent naturalists refer several distinct cases to other sources, which in the following pages will be claimed as examples of what, for want of a better name, we have styled *directive coloration.* And whether the views hereinafter to be advanced prove to be entirely novel or not, they have, so far as here expressed, sprung entirely from the author's own observation and study. He regrets that both have necessarily been so limited that he cannot multiply examples as freely as nature has supplied them. What is here offered is only a sketch of what might be wrought out by any one having time to carry out the work in its details.

The first observations which eventually proved the germ of this paper were made on the plains of Dakota. During the long, monotonous rides over that region, one pleasant circumstance was the sudden rise of various birds from the nearly naked ground and their as sudden disappearance on lighting. Ere long it was noticed that in the process of lighting there was, very commonly, a conspicuous flashing-out of white on wings or tail, or on both. This was noticed in several of the sparrows, the meadow-lark, the lark-bunting, the Carolina dove, and less prominently in the prairie-hen or grouse. Somewhat similar facts were noted also of the jack-rabbit and antelope. The question then arose, very naturally, Why is this prevalent character? Of what advantage is it? For the smaller birds, the answer came readily. The plains are constantly scoured by hovering hawks—therefore, protective coloration is of prime importance. If, however, they should become of a uniform gray color all over, they would be as completely and constantly hidden from their friends as from their foes. That would be quite disastrous, especially where the former are fewer than the latter. To prevent such a result, there is the following arrangement. When at rest, or about the ordinary occupation of feeding, the gray surface only is exposed; the same is true also in some cases during flight; but in checking its velocity for lighting the tail is fully spread, exhibiting the conspicuous colors fully, and marks the location of the leader, that the rest may govern themselves accordingly. To escape the hawk, should he happen to note the location, the sparrow resorts to doubling on its course and skulking. When the danger has passed, the flock, if they have followed the leader, are likely to be within call of one another, and if they have become too much scattered, this same automatic telegraphy must assist much in enabling the stragglers to find their fellows. Some species, as the meadow-lark, have a habit of spreading the tail at almost every chirp. This would seem to work as rationally as the rallying-call of the bugle and the waving of a flag to call a troop together. Yet after all, in the bird it is doubtless mainly automatic, the effort of the cry producing the twitch of the tail, as truly as in the prairie-dog.

But this conspicuous flash tells more than the place of alighting. It reveals the species at hand. These white patches form a kind of natural heraldry among the denizens of the plains, by which each kind is recognized by friend and foe. Its vivid white secures

its utmost efficiency. It is, no doubt, often useful also at night, whenever there is any disturbance by storm or prowling enemy. Thus far, we have had in mind only the ordinary gray birds and animals of the plains, upon which the directive coloration is almost invariably white. But the principle extends farther. When the general coloration is white or light, the directive color is black or dark, as in the pelican, white crane, weasel, etc. In some which may be gray in summer and white in winter, both white and black may be found in close juxtaposition. In a very few, black seems to serve the purpose, even with gray plumage, as in the horned lark and some sparrows (?). The principle may include also cases where more brilliant tints than those of the white-black series are employed.

Soon after our interest had been awakened in the cases already mentioned it was our privilege to examine a large collection of skunks which some fortunate trappers had captured. The striking white lines on the black ground and their fantastic and very variable forms raised again the question, *Why?* Our idea of directive coloration found a new direction for its application, and it readily suggested satisfactory answers to the query. Here were animals living constantly in dusk and darkness. The conspicuous tail, as Belt remarked long ago, may be classed as a warning signal, and therefore protective; but why the elaborate white lines and spots? These are only useful at shorter distances, and, therefore, presumably to fellow-individuals of the same species. We can readily understand how they may clearly reveal not only the general position of the body, but also its attitude; and by the individual variations in the breadth and continuity of the lines, individuals may recognize one another at night, or in their burrows. In short, these directive markings are in this case what signal-lights or flags are to vessels and cars, Similar reasoning accounts for the markings prevalent in the raccoon. badger, chip-munk, and other burrowing animals. So, too, it accounts for some of the markings about the heads of the sparrows, larks, ducks, and numerous other birds; also, about the muzzle, ears and throat of antelope, deer, hares and other mammals, whether protectively colored or not. These markings are more distinct and more frequent about the head, because of its greater expressiveness and importance. Of course, in this general outlining of our idea we need not attempt to classify rigidly particular markings, for some

may be useful in more than one way. For example, the ears of the jack-rabbit may serve to notify his fellow of his presence at a distance, and when close at hand they, doubtless, are very expressive of the bodily position and mental condition of their owner.

Looking now over the whole animal kingdom, so far as the more comprehensive works on natural history and more careful descriptions of our local faunas will allow us, we find a vast number of spots and lines about the head, shoulders, flanks and tails of animals belonging to all the so-called sub-kingdoms; and we find in our theory a plausible explanation, in harmony with the workings of natural selection.

We find some, however, which, while properly associated with the cases already described, do not come under either of them exactly. Hitherto we have considered where only a few individuals were concerned and only in the casual relations of ordinary life. There are cases where large numbers herd together, oftentimes moving rapidly in crowded phalanx or disorderly mass, where each must closely regulate his movements according to the action of his immediate companions if he would avoid collision and injury. Not only is this important in diurnal travels, but in the nocturnal bivouac, and especially in a stampede at night. In this way we may explain the stripes of the zebra, koodo, etc., and the numerous bright and extended markings on the various African antelopes. It would seem that the greater and more ferocious carnivores of the tropics might have an influence to intensify these features. The bright markings of hyenas and the hunting-dogs are other conspicuous examples, traceable to quite a different combination of circumstances. Less striking marks, which we have noted under another head, may be also helpful in the way just described. For instance, the markings about the head and tail of wild geese and ducks and the black tips of the wings of pelicans may assist them much in keeping their regular order of flight; so, also, the markings upon sparrows, which are helpful in the ways already indicated, during their summer-life may also be of service during their migrations by helping them to harmonize their movements.

It will be seen by a moment's thought that most of the markings helping to show the position of the body may be of pre-eminent value during courtship, especially during the supreme moments of coition. It would not be strange if this advantage might have a tendency

to intensify certain lateral and caudal markings, or even to produce in them sexual differences. We should naturally expect this to be as manifest in nocturnal animals as anywhere. To this cause we are disposed to refer the different colors of the wing-spots of night-hawks and other Caprimulgidæ: In the males they are white, while in the females they are rufous. Possibly, some of the cases which Darwin considers the results of sexual selection transferred from the male to the female may be referred to this influence.

Another relation may, presumably, modify directive coloration to a considerable degree, especially in animals which, though roving the fields themselves, secrete their young. Deer, swine, lions, etc., may be taken as examples of this. The vivid markings upon the young may assist much in the care which the mother gives in the dim light of the hiding-place and at night. This explanation does not necessarily conflict with the more commonly received opinion —that they are the effect of heredity, revealing the coloration of some remote ancestor. It suggests, rather, the further inference that that ancestor was either gregarious and living on open plains, or else was more solitary and prowling, skulking in dim lights. Our theory would offer a rational explanation for its persistence in the earlier stages of living species.

It will be noticed that we have drawn our illustrations entirely from the mammals and birds. We would not imply that our theory is limited to these. Insects, fishes and reptiles may afford equally good examples.

We would remark, in conclusion, that this sketch does not attempt to give details more than may be necessary to present our view intelligibly. Of course, we recognize the validity of the theory of typical coloration consisting of those primal tints and patterns which have been ascribed to the combined action of chemical, physical and vital forces only; also the theories of protective and ornamental colorations, which have been evolved from the typical by the action of natural and sexual selection. We do not profess to be able to refer every tint and pattern of coloration to its predetermining condition or advantage. That would be well-nigh impossible. But if enough has been given and with sufficient discrimination to satisfy most minds, that adaptation for directive purpose is a real advantage which has been decidedly effective in determining the coloration of animals we are content.

A Synopsis of Directive Coloration in Animals.

Directive coloration is that which is in any way useful to a species by assisting in mutual recognition between individuals, or by indicating, one to another, their attitude of body and probable movements.

1. Marks and tints, promoting recognition at a distance, to guide in straggling flight and to bring stragglers together. [A.]

2. Those indicating the attitude of the body and its probable movement [B] in darkness of night, or in dens; [C] in close movements of large numbers, by day as well as by night; [D] in intercourse of the sexes; [E] in the care of young.

A. [a] By having the general color more or less strikingly contrasted with the environment.—Crows, buzzards, blue-birds, woodpeckers, etc.

[b] When general color is inconspicuous: by having striking colors upon parts of the body which may be hidden during rest, but capable of display automatically either during flight, at the moment of stopping, or during a calling cry, viz.:

Conspicuous colors about the tail:—[Mammals] Rabbit, deer, prong-horn, many antelope, Rocky Mountain sheep, chamois, etc., etc. Outer tail-feathers conspicuous:—[Birds] Snow-bird, meadow-lark, many finches, robin and many thrushes, most warblers, many vireos, night-hawk, ptarmigan, horned-lark, etc. A terminal band: Turkey, king-bird, and many fly-catchers, turtle-dove and other pigeons, grouse, etc. Under-coverts: Prairie-hen, coot, galinule, many snipe, many ducks and geese, etc. Rump and upper coverts: Hawks, flickers, and other Picariæ, most geese, etc.

Conspicuous colors about lateral appendages:—In Mammals, the ears (more frequently on the back side)—hares, deer, etc.; in Birds, the wings—many finches, coots, upland-plover, pelican, snow-goose, crane, many warblers, vireos, etc.

B. [a] By striking marks about the head and neck:—[Mammals] Raccoon, badger, skunk, coatis, many antelope and rodentia, etc. [Birds] Many raptores, sparrows, fly-catchers, warblers, anseres, etc., etc.

[b] By various spots and lines on shoulders or sides:—Skunks, chip-munks, antelope, peccaries, chevrotains, etc.

[c] By paleness of belly and inner side of legs:—Cases too numerous to name.

C. [a] Not only by many of the markings already described, but especially by more vivid and extensive marks upon the shoulders, sides and flanks :—Zebra, wild asses, antelope, giraffe, hunting-dogs, etc.

[b] By special marking of the legs and feet upon the outside :—Zebra, antelope, etc.

D. [a] By most of the lateral and caudal markings already mentioned.

[b] By different colors, according to sex :—Night-hawks and other Caprimulgidæ.

[c] By difference in extent or shape of markings, according to sex :—Antelope, etc.

E. By various spots and lines, appearing only in the younger stages :—Deer, some swine, some Felidæ, etc.

SYNOPSIS OF ROSENBUSCH'S NEW SCHEME FOR THE CLASSIFICATION OF MASSIVE ROCKS.

BY W. S. BAYLEY.

ACCORDING to the new scheme for the classification of massive rocks, proposed by Professor H. Rosenbusch of Heidelberg in the second edition of his "Mikroskopische Physiographie der Massigen Gesteine," these are divided into three great groups, (I) intrusive rocks, (II) vein rocks, and (III) effusive rocks. The fundamental notion underlying this classification is briefly as follows: the structure possessed by rock masses as we find them in the earth is dependent upon two circumstances—(1) the chemical composition of their original liquid magmas, and (2) the conditions under which these magmas cooled. The effect of chemical composition upon the structure assumed by a rock magma in its passage to a solid state has not been definitely ascertained. Results recently obtained by Lagorio, however, indicate that the composition of the unsolidified portions of rock masses, exerts much more influence upon the final structure of the rock than has hitherto been supposed. The rapidity with which a rock cooled, as well as the conditions under which this took place, have long been known to be quite influential in determining its structure. Those rocks which cooled

slowly under great pressure and at great depths, where crystallization was gradual and undisturbed, assumed a granular aspect. Those which cooled quickly under low pressure became glassy. Those which began to crystallize in the depths of the earth, and continued their crystallization after the transference of their entire mass to other places, took on a porphyritic habit. Since, then, the structure of a rock indicates with some degree of certainty the prevailing conditions under which it was formed, it affords a convenient basis for the foundation of rock classification. And further, since the conditions under which a rock is formed are directly connected with its geological relations to surrounding rocks, the most logical classification is that which takes primarily into consideration these relations as the causes which produce the effects noted as structure.

Rosenbusch begins, then, by separating all massive rocks into the three great groups mentioned above. The intrusive or plutonic rocks are those which formed at great depths (Tiefen-gesteine); the effusive or volcanic rocks are those which flowed out upon a land surface and there solidified (Erguss-gesteine), and finally the second group, the vein rocks, are those which have been found only in veins or dykes in other rocks, and which may or may not be connected with the effusives.

Before discussing the classification in detail it will be necessary to define a few terms introduced by Rosenbusch to facilitate the description of the more prominent structures characterizing rocks, as we find them to-day.

A rock composed entirely of crystalline minerals is said to be *holocrystalline.* When it consists entirely of an unindividualized, structureless mass, it is known as *amorphous.* When it is partly amorphous and partly crystalline, *i.e.*, contains crystals in a hyaline ground-mass, the structure is described as *hypocrystalline.*

An *idiomorphic* mineral is one whose form is determined by the crystallizing forces acting within itself. An idiomorphic mineral is bounded by crystal planes. An *allotriomorphic* mineral is one which possesses a form due to the action of external forces, and not to the action of intramolecular forces. An allotriomorphic mineral is not bounded by its own crystal planes. Of two contiguous minerals in a rock, one idiomorphically developed, and the other allotriomorphically developed, the former is the older, compelling

the latter to assume a form which it would not do were it free to obey the forces at work within itself, tending to bound it with certain definite crystal planes.

A mineral is described as occurring in but *one generation* in a rock when all of its individual members have separated out continuously in the same interval of the rock's formation. When a portion of the individuals have separated out during one interval, and then, after other minerals have crystallized, another portion has separated, the mineral is said to occur in *two generations*.

When the constituents of a rock occur in but one generation, the rock is *granular* in structure. When but a small portion of these are idiomorphically developed, the rock is *hypidiomorphically granular*. When a relatively large portion or all of the constituents are idiomorphically developed, the rock is *panidiomorphic*. When none of the constituents are so developed the structure is *allotriomorphically granular*.

A *porphyritic* rock is one which contains one or more minerals in more than one generation.

I. Intrusive Rocks.

The intrusive or plutonic rocks are those which were formed at great depths. They were intruded between other rocks which existed before them, either as bosses or sheets, which never reached the surface, or they are the deep-seated portions of large masses which may have flowed out upon the surface of the earth. They may have been formed at any geological age, but are only found in the oldest portions of the globe, because only in these portions has sufficient time elapsed to allow of their exposure by erosion.

They are characterized by the possession of a hypidiomorphic granular structure, although in certain cases, where these rocks were intruded as flows between others, they sometimes tend to the panidiomorphic development.

They are divided, according to their chemical and mineralogical compositions, into eight families.

A. THE GRANITES.

The granites are composed essentially of quartz and an alkaline feldspar, and one or more of the minerals of the mica, amphibole or pyroxene groups, sometimes tourmaline, and almost universally certain apatite, zircon and iron oxides.

They are divided into three divisions, as follows:—

1. True Granites, containing both light- (muscovite) and dark-colored micas (biotite, etc.), including
   - (a) *lithionite granite,* in which the dark ingredient is a lithium mica.
   - (b) *luxullianite,* in which tourmaline replaces the lithionite.
2. Granitites, containing a biotite as its only micaceous constituent, including
   - (a) *lithionite granitite,* with a lithium mica as the prominent micaceous constituent.
   - (b) *amphibole granitite,* containing an amphibole in addition to biotite.
   - (c) *augite granitite,* in which an augitic mineral is present.
3. Amphibole Granites, containing amphibole in place of the biotite of the granitites.

B. THE SYENITES.

Syenite differs from granite in the entire or almost entire absence of quartz as an essential constituent. The syenites besides contain no primary muscovite, but do contain a greater or less amount of plagioclase. The alkaline feldspars embrace, in addition to orthoclase, both albite and anorthoclase to a subordinate degree.

They are divided into:—

1. True Syenites, or hornblende syenites, composed of orthoclase, hornblende, and usually a little biotite.
2. Mica Syenites, which often contain albite in addition to orthoclase and biotite.
3. Augite Syenites, in which a monoclinic augite and orthoclase constitute the essential components.

C. THE ELÆOLITE SYENITES.

The elæolite syenites are quartz-free combinations of orthoclase and elæolite with one or more of the iron-bearing minerals of the pyroxene, amphibole or mica groups. With these is almost always associated some plagioclase and a greater or less amount of sodalite.

Their structure, though usually granular, sometimes becomes porphyritic through the occurrence of feldspar, elæolite and sodalite in two generations. It is probable that this structure is con-

fined to the outer edges of large masses and dyke forms of the kroc. The various occurrences of elæolite syenite are not well enough characterized to admit of a further classification.

D. THE DIORITES.

The diorites may be defined as rocks composed of plagioclase and biotite or hornblende, with or without quartz. Orthoclase and microcline sometimes accompany the plagioclase, and in certain cases augite partly replaces the biotite or hornblende. The structure of the diorites departs somewhat from the typical structure of the intrusive rocks in that the plagioclase and the biotite, amphibole and augite are sometimes idiomorphically developed.

The diorites are divided into:—

1. Mica Diorites, in which biotite predominates over hornblende, including
   - (A) *mica diorite,* which is quartz-free.
   - (B) *quartz, mica diorite,* which is quartz-bearing.
2. Diorites, in which hornblende is the most prominent colored constituent, including
   - (A) *diorite,* and
   - (B) *quartz diorite.*
3. Augite Diorites, containing a large amount of augite, including
   - (A) *augite diorite,* and
   - (B) *quartz-augite diorite.*

E. THE GABBROS.

The gabbros are combinations of plagioclase and a monoclinic or an orthorhombic pyroxene, with or without olivine.

Their structure varies slightly from the typical granular structure, in that the plagioclase occurs in broad lath-shaped crystals.

They are divided, according to the nature of their pyroxenic constituents into:—

1. Gabbros, which contain, as their pyroxenic constituent, diallage, or a monoclinic augite with a composition approaching that of diallage.

   The gabbros include
   - (A) *gabbro* proper, which is olivine-free, including two varieties:

(*a* 1) hornblende gabbro, in which diallage is partly replaced by hornblende, and

(*a* 2) hyperite, containing a little olivine and some orthorhombic pyroxene.

(B) *Olivine gabbro*, olivine-bearing.

2. NORITES, which contain an orthorhombic augite as the principal pyroxenic component.

The norites are divided, according as to whether they contain olivine or not, into

(A) *norite*, and

(B) *olivine norite.*

F. THE DIABASES.

The diabases are composed essentially of plagioclase and augite, with or without olivine and quartz.

They form a well-marked class among the intrusive rocks, which differs in many respects from the other intrusives, and approaches very near in characteristics to some of the effusives. This is due principally to the fact that the diabases occur as dykes and intruded layers between sedimentary beds, and thus tend to assume in some degree the structure possessed by sheets which have cooled on the surface under atmospheric pressure alone. They are frequently accompanied by tufas, and they often possess amygdaloidal upper surfaces. Since, however, the pressure under which they were formed was much greater than that under which the volcanic rocks were produced, and, as we may suppose, their cooling much more gradual, the diabases are holocrystalline and hypidiomorphic-granular, as distinguished from the hypocrystalline and porphyritic structures of the members of the effusive class. Nevertheless, the tendency of the plagioclase to assume idiomorphic forms is so strong that an approach to the porphyritic structure is noticeable in many diabases. As among the gabbros, the first differentiation of the diabases is dependent upon the presence or absence of olivine as an essential constituent.

1. DIABASES are olivine-free combinations of plagioclase and augite, usually with a little hornblende and mica.

(A) *diabase* proper contains no quartz.

(B) *quartz diabase* contains quartz as a primary component, including

(*b* 1) sahlite diabase, which contains an idiomorphic colorless monoclinic pyroxene (sahlite), and

(*b* 2) enstatite diabase, containing an orthorhombic augite.

(c) *teschenite* is analcite-bearing.

2. Olivine Diabases contain olivine as an essential constituent in addition to plagioclase and augite.

G. THE THERALITES.

The theralites, formerly called teschenites, are intended to embrace rocks composed of plagioclase and nepheline, together with the accessories augite, biotite and olivine. Rocks of this composition are not known to exist among the intrusives, unless certain basic rocks from Montana, lately described by Mr. Wolff, belong here. Corresponding members of the effusive class are, however, quite well known, and it is therefore expected that true theralites will be found at some time in the future, even if the Montana rocks should turn out not to belong in this family.

H. THE PERIDOTITES.

The peridotites are the most basic of the intrusive rocks. They contain no plagioclase, but usually do contain a large amount of olivine and a mineral of the amphibole or pyroxene families. Their bisilicate constituent is made use of for purposes of sub-classification.

1. Picrite is composed of olivine and augite.
2. Amphibole Picrite contains olivine and hornblende.
3. Wehrlite consists of olivine and diallage.
4. Harzburgite is a combination of olivine and a rhombic pyroxene.
5. Lherzolite contains olivine, diallage and a rhombic pyroxene.
6. Dursite consists of olivine and chromite

II. Vein Rocks.

The class of vein rocks includes those which exist as independent geological bodies only in the form of veins or dykes, although many similar rocks occur also as facies of certain intrusive and effusive rocks. This class is not as well defined as either the intrusive or the effusive class. Rosenbusch personally is inclined to place them

with the intrusives, but since no direct connection has been traced between them and deeply buried rock masses, of which they may be regarded as a part, he decides to place them in a separate group until more knowledge of their relations has been obtained.

The structure of the vein rocks resembles in some respects that of the intrusive rocks, and in others that of the effusives. Three well-marked types are recognizable: the granitic, the granite-porphyry, and the lamprophyre. Since these three types can be distinguished macroscopically, and are very characteristic, they are made use of to separate the vein rocks into three groups, which are in turn subdivided into families, according to mineralogical constitution, as in the class of intrusive rocks.

II. A. The Granitic Vein Rocks.

The structure of the granitic vein rocks differs from that of the intrusive rocks, in that their individual constituents tend to become idiomorphic. In most cases this tendency has gone so far as to produce a rock, all of whose components are bounded by their own crystal outlines. They are then panidiomorphic-granular. An approach to the porphyritic development is sometimes the result of a repetition of conditions which allows of the separation of some of the constituents in two generations.

The granitic vein rocks include:—

1. Aplite, or muscovite granite, consisting of orthoclase, quartz and muscovite.
   - (a) *pegmatite* is a coarse-grained aplite.
   - (b) *beresite* is orthoclase-poor aplite.

II. B. The Granite Porphyry Group.

The structure characteristic of this group of rocks is the holocrystalline-porphyritic. Their ground mass is a granular aggregate of crystalline minerals. The predominant porphyritic crystals are light in color, *i.e.*, they are neither iron nor magnesia bearing. The occurrence of iron and magnesia-bearing minerals as porphyritic constituents is exceptional.

The group is divided into:—

a. the granite porphyries.

The mineralogical composition of this family is the same as that

of the granites. The porphyrytic constituents are quartz, orthoclase, and usually one or more of the granitic minerals, biotite, hornblende, augite or muscovite. The same minerals occur also in the ground mass.

No attempt is made to divide the granite porphyries, although it may be convenient to separate them into:—

1. Granite porphyry proper, containing no muscovite, and
2. Elvan muscovite—rich varieties.

B. THE SYENITE PORPHYRIES.

The syenite porphyries differ from the granite porphyries in the absence of quartz from among the porphyritic crystals. In all other respects they are similar to them. Quartz occurs in the groundmass, and plagioclase is more common than in the granite porphyries.

They are divided, according to their principal iron-bearing constituent, into:—

1. Hornblende syenite porphyry, which contains orthoclase and hornblende as the most prominent porphyritic constituents.
2. Mica syenite porphyry, in which orthoclase and biotite occur in porphyritic crystals.
3. Augite syenite porphyry, in which augite is the most important non-feldspathic porphyritically developed component.

C. THE ELÆOLITE SYENITE PORPHYRIES.

The elæolite syenite porphyries usually contain elæolite as the most important porphyritic constituent after orthoclase. In one or two cases the elæolite is found only in the groundmass. Rocks belonging to this family have not been sufficiently studied to admit of further classification.

D. THE DIORITE PORPHYRITES.

The diorite porphyrites are not very widespread. They consist of plagioclase, hornblende, and sometimes quartz and biotite as porphyritic crystals in a groundmass composed principally of plagioclase and quartz.

They are divided into families, in accordance with the existence or non-existence of quartz among the porphyritic crystals.

D. *a*. DIORITE PORPHYRITES.

1. DIORITE PORPHYRITE contains plagioclase and hornblende as porphyritic constituents.
2. MICA DIORITE PORPHYRITE contains plagioclase and biotite in porphyritic crystals.

D. *b*. QUARTZ DIORITE PORPHYRITES.

1. QUARTZ DIORITE PORPHYRITE contains plagioclase, quartz and hornblende as the porphyritic ingredients.
2. QUARTZ MICA DIORITE PORPHYRITE. In the rocks of this class biotite takes the place of the hornblende in the quartz diorite porphyrites.

II. E. THE LAMPROPHYRE GROUP.

The lamprophyre group differs from the granite porphyry group of vein rocks in that the iron and magnesium-bearing silicates, hornblende, pyroxene and biotite are the most important constituents occurring in two generations. Their feldspar, which may be either orthoclase or plagioclase, occurs in but one generation.

In composition they resemble the syenites and diorites of the intrusive rocks, and are therefore divided in accordance with this resemblance.

A. SYENITIC LAMPROPHYRES.

The syenitic lamprophyres consist of an alkaline feldspar, biotite, hornblende and pyroxene as essential constituents.

They possess both the panidiomorphic-granular and the holocrystalline-porphyritic structure. The former sometimes passes over into the hypidiomorphic-granular.

They are subdivided according to the presence or absence of biotite as a prominent constituent.

1. MINETTES contain biotite as the principal iron-bearing constituent, both in the granular and the porphyritic forms.
   (A) *hornblende minettes* contain hornblende in addition to biotite.
   (B) *augite minettes* have augite besides biotite as a prominent constituent.

(*b* 1) olivine minette is an augite minette containing olivine.

2. VOGESITES contain hornblende or augite as the most important colored constituent.

   (A) *hornblende vogesite.* In this, hornblende predominates over augite.

   (B) *augite vogesite* possesses augite in larger quantity.

B. DIORITIC LAMPROPHYRES.

The dioritic lamprophyres differ from the syenitic lamprophyres in containing plagioclase instead of an alkaline feldspar in addition to biotite, amphibole and augite.

Like the syenitic varieties, these rocks are also developed with the panidiomorphic granular and the holocrystalline porphyritic structures.

Their separation into two classes also depends upon the greater or less amount of biotite in their composition.

1. KERSANTITE. This rock is characterized by the possession of large amounts of biotite.

   (A) *Aschaffite* contains quartz and feldspar in addition to the iron-bearing minerals in porphyritic development.

   (B) *Olivine kersantite* contains olivine in addition to the essential constituents of the kersantite.

      (*b* 1) *pilite kersantite,* in which the olivine has been altered to pilite.

2. CAMPTONITE contains hornblende in place of the biotite of the kersantites.

(TO BE CONCLUDED.)

X.—GLACIAL EROSION IN NORWAY AND IN HIGH LATITUDES.[1]

BY PROFESSOR J. W. SPENCER, B.A.SC., PH.D., F.G.S.

I.

DURING the summer of 1886, it was my good fortune to visit the three largest snowfields in Norway, namely, the Folgefond, at the head of Hardangerfjord in southern Norway, whose area is 108 square miles; the Jostedalsfond, two degrees to the north, beyond Sognefjord, whose area is 580 square miles, and the largest snowfield in Europe; and the Svartisen, extending from just inside the arctic circle for forty-four miles northward. All of these snowfields send down glaciers to within from 50 to 1,200 feet of the sea. These snowfields are not basins like those in the Alps, but are mantles covering the tops of plateaus from 3,000 to 5,000 feet or more above the tide, from which great cañons suddenly descend to the sea, and extend themselves as fjords, from 1,000 to 4,000 feet in depth.

Many of the Norwegian glaciers are rapidly advancing. In their progress they do not conform to the surfaces over which they pass, but are apt to arch over from rock to rock and point to point, especially as they are descending the ice-falls. Thus are produced great caverns into which the explorer can often wind his way for long distances.

Beneath the glaciers of Fondal, Tunsbergdal, and Buardal, in the northern, north-central, and south-central snowfields of Norway, as well as under other glaciers, I observed many stones enclosed in ice, resting upon the rocks, to whose surfaces—sometimes

[1] Read before the Royal Society of Canada, May 25, 1887, and the American Association for the Advancement of Science, New York, Aug. 1887. Printed from advanced sheets of the Proc. Roy. Soc. of Canada. See also "The Erosive Power of Glaciers as seen in Norway," Geol. Mag., London, Dec., iii., vol. iv., 1887, and "Ice Action in High Latitudes," ibid., vol. v., 1888, by Prof. J. W. Spencer, M.A., Ph.D., F.G.S.

flat, sometimes sloping steeply—they adhered by friction, and by the pressure of the superincumbent weight. Although held in the ice on four sides, with a force pushing downward, the viscosity of

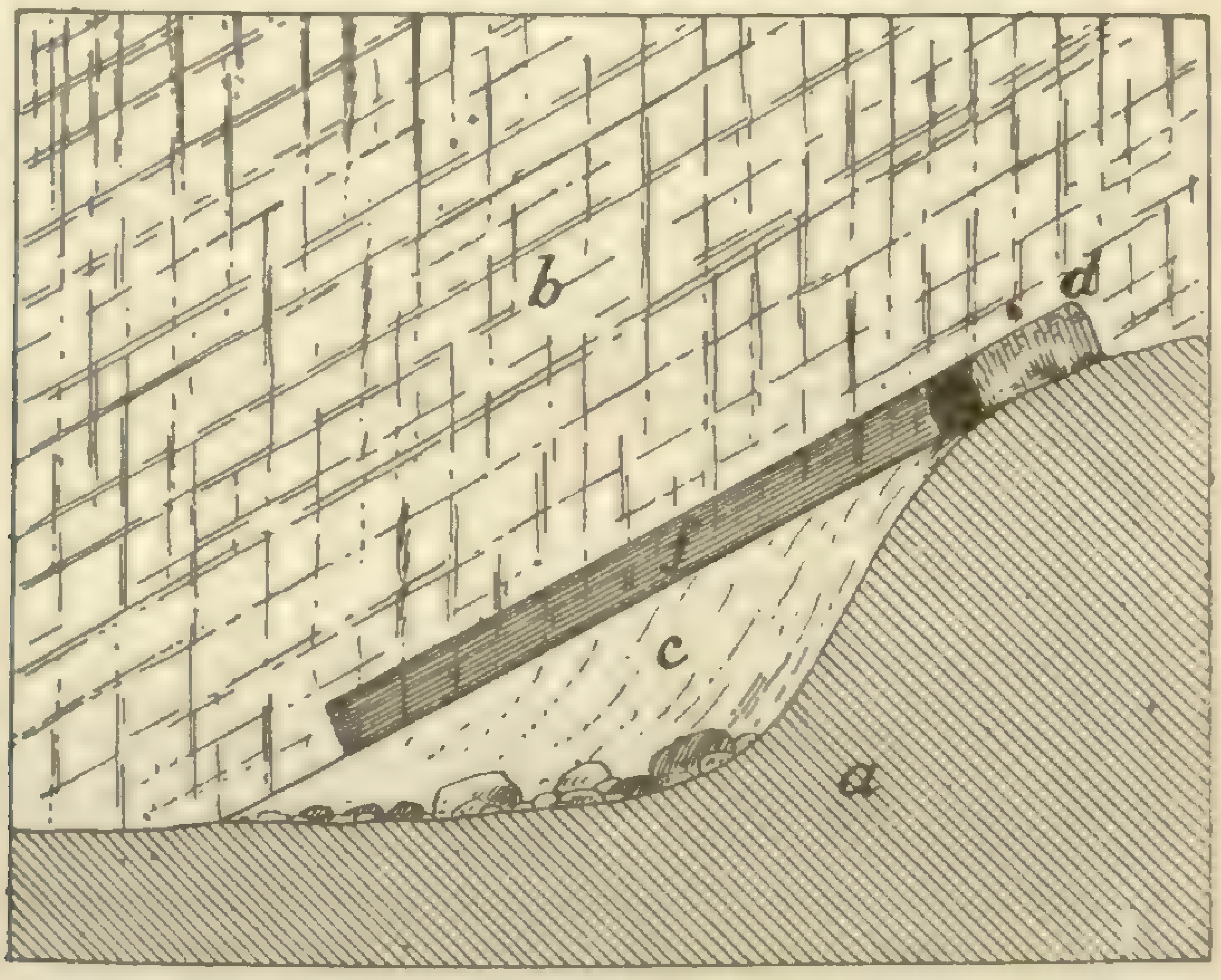

FIG. 1.—Section of Fondalsbræen, *a*, bed rock; *c*, cavern under glacier *b*; *d*, loose stone; *f*, groove under the ice.

the ice, or the resistance of its molecules in disengaging themselves from each other in order to flow, was less than that of the friction between the loose stones and the rock; consequently the ice flowed around and over the stones, leaving long grooves upon the under-surfaces of the glacier. The first observation made was at Fondalsbræen (Fig. 1), where an angular stone (Fig. 1 *d*) whose section was ten by eighteen inches, rested upon the sloping face of smooth rock (*a*). For twenty feet below the stone, the under-surface of the glacier was grooved (*f*) by the moulding of the ice about the obstacle. This distance showed the advance of the glacier after the stone had come in contact with the rock, for it had evidently been completely buried at the lower end of the groove, before the ice had begun to flow about it. As the ice between the stone and the rock gradually disappears, the embedded stone does not suddenly cease to move, but drags, until enough of the surface rests upon the rock to allow of friction between the two granitoid surfaces to overcome the viscosity of the ice, when the latter flows around the obstacle. Elsewhere, an example was seen of this action. The knife edge of a wedge-shaped piece of gneiss was protruding beneath the ice and resting upon the rock. The front end of this stone had moved beyond the subjacent surface, while the posterior

end was still upon it. Yet the sharpness of the edge had scarcely been blunted.

Abundant examples were found to show that the flowing of the ice about loose obstacles was quite the rule. Both large and small (even an inch in length), angular and rounded masses, lying either upon the rock, or upon morainic matter, were sufficient to channel the bottom of an advancing glacier. No blocks of rock were seen in the act of being torn loose from the floor or sides of the valley, and certainly there were no loose or solid masses being picked up by the advancing glacier.

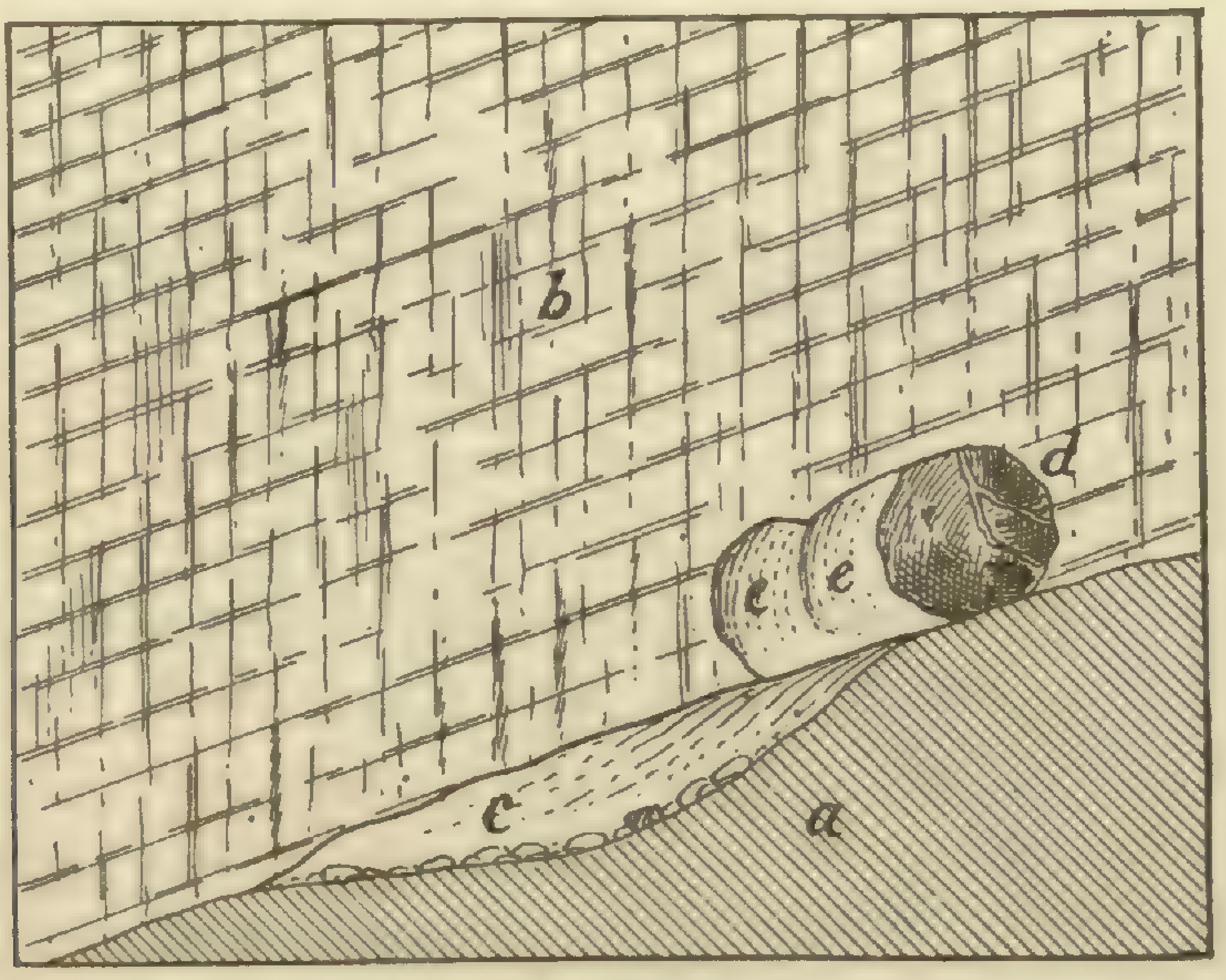

FIG. 2.—Section of Tunsbergdalsbræen, *a*, bed rock; *c*, cavern under ice *b*, *d* boulder; *ee*, moulding in ice of the form of *d*.

At Tunsbergdalsbræen (Fig. 2), whose lower end is 1,600 feet above the sea, a modification of the above described phenomena was seen. A roughly rounded boulder (Fig. 2 *d*) of thirty inches diameter was enclosed in the convex side of the glacier, which rose above it from thirty to forty feet in height. It was resting upon a surface, sloping at a high angle, and was held in place by the ice itself. As the surface of the stone, bearing upon the rock, was small compared with that held in the ice, it should have been dragged along. But it was being rolled, as shown by the moulding (*e e*) of its form in the glacier which was advancing faster than the stone was rolling down the steep slope. The pressure upon this stone could not have been merely that of the superincumbent ice, a few feet thick, but also that of a powerful component of the weight of a glacier from 1,500 to 2,000 feet high descending more or less

like a fluid. The energy upon the boulder was sufficient to crush it into one large and two smaller masses, together with stone dust. When seen, the three fragments had hardly begun to part company.

The abrasion of the solid rock by the fall of stones, and detached masses of ice and stones, was illustrated at the locality just named. The two guides and myself succeeded in detaching a large boulder of about five tons weight, adjacent to the edge of the glacier. It went rolling and sliding down a hundred feet or more, tearing away great blocks of ice which held a considerable amount of debris, and in its wake, the rock was more or less crushed or scratched.

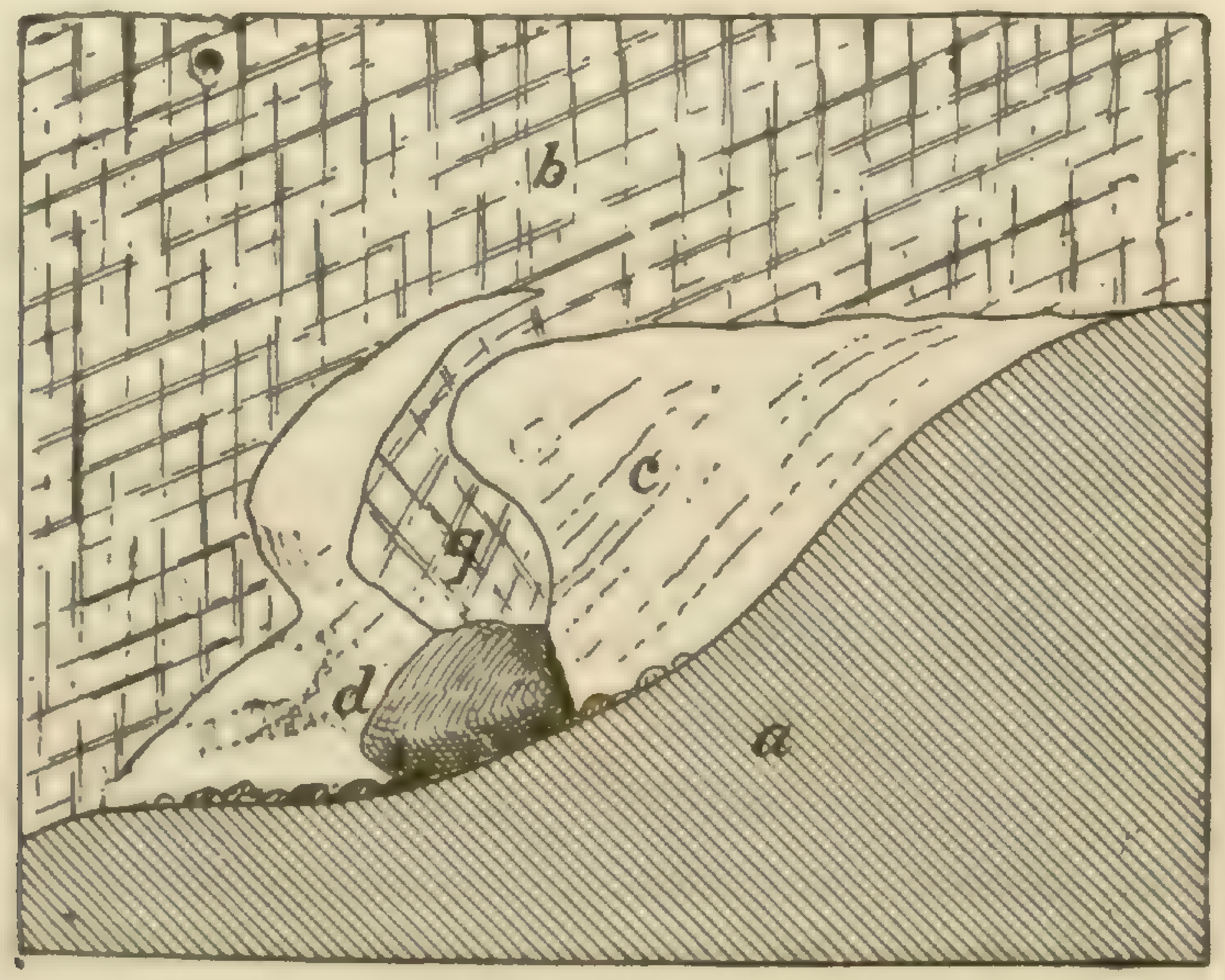

FIG. 3.—At Tunsbergdalsbræen, *d*, a loose boulder, resting on rock *a*, in cavern *c*, against which a tongue *q*, of the moving glacies *b*, impiges and is bent backward.

A further example of the ability of the ice to flow like a plastic body was shown in a cavern (Fig. 3 *c*) 400 feet higher than the end of the glacier, where the temperature was 4°C., while that outside was 13°C. Upon the debris of the floor rested a rounded boulder (*d*) whose longer diameter measured thirty inches. A tongue of ice (*q*), in size more than a cubic yard, was hanging from the roof, and pressing against the stone. In place of pushing the stone along or flowing around it, the lower layer of ice above the tongue had yielded, and was bent backward as easily and gracefully as if it had been a thin sheet of lead, instead of one of ice a foot thick.

According to the experiments of Herr Pfaff,[1] the temperature of

[1] Nature, Aug. 19, 1875.

ice has a great deal to do with its flow about obstacles. Below freezing-point, the movement is scarcely more than appreciable, while above that point, but not below, it may reach twenty-eight inches a day, or more. The conditions arising from the temperature beneath the glaciers are more or less favorable for the movement of the ice, as the lower surfaces are never entirely below freezing-point, even in winter. Professor S. A. Sexe[1] found that the water flowing from a Folgefond glacier, in February, 1861, had a temperature of 1°R., whilst that of the air was 7°R. below freezing-point.

The movement or flow of the ice about detached stones, resting upon rocks, has been observed by Professor Sexe beneath the Buarbræ, and by Professor J. W. Niles beneath the Aletsch glacier.[2] Professor Sexe illustrates the moulding of the ice about a loose stone, which was held beneath the glacier by a projection of the rock. My observations were upon stones, not held up by rocky projections, but upon surfaces often sloping downward. Although Professor Niles did not record observations showing that there was definite movement of the stone, yet he concluded that there was a differential movement of the ice and the block. Whatever differential movement there is, it must be very inconsiderable, not only upon horizontal plains, but upon inclined surfaces. In the former case the movement of the ice is reduced almost to zero, as shown by the measurements of Professor Tyndall upon the Morteracht, where the velocity of the surface, some distance from its end, was fourteen inches, whilst that of the tongue of the glacier, as it reached the plain, was only two inches a day.[3]

The most important condition favorable for holding stones in ice as graving tools is low temperature, which impedes its progress; but this condition beneath glaciers does not generally exist. At higher temperatures, the velocity of the glacier is not great enough to overcome its plastic movement and to drag along detached blocks. However, when the whole mass of ice is charged with sand and stones, there is no doubt that polishing and scratching are effected; but when there are only occasional fragments in the bottom of the ice, as is commonly the case, the erosion from the sliding ceases as

[1] Om Sneebræen Folgefon, af S. A. Sexe.

[2] American Journal of Science, Nov., 1878.

[3] Tyndall's Forms of Water.

soon as the resistance due to friction between the stones and the rock equals that due to viscosity, which, as observations show, is soon reached. Consequently, we should not expect to find great troughs or grooves scooped out of solid rock by the actual glacier. These I have not seen about the existing glaciers of Norway, which are not dependent upon atmospheric and aqueous erosion and the texture of the rock, although their surfaces may have been subsequently polished. Generally speaking—as seen in the valley behind Fondalen Gaard, where the glacier is nearly free from sand, and contains comparatively few stones, as well as at many other places—the surfaces of the subjacent crystalline rocks, although of the form of *roches moutonnées*, with angles mostly removed, are not

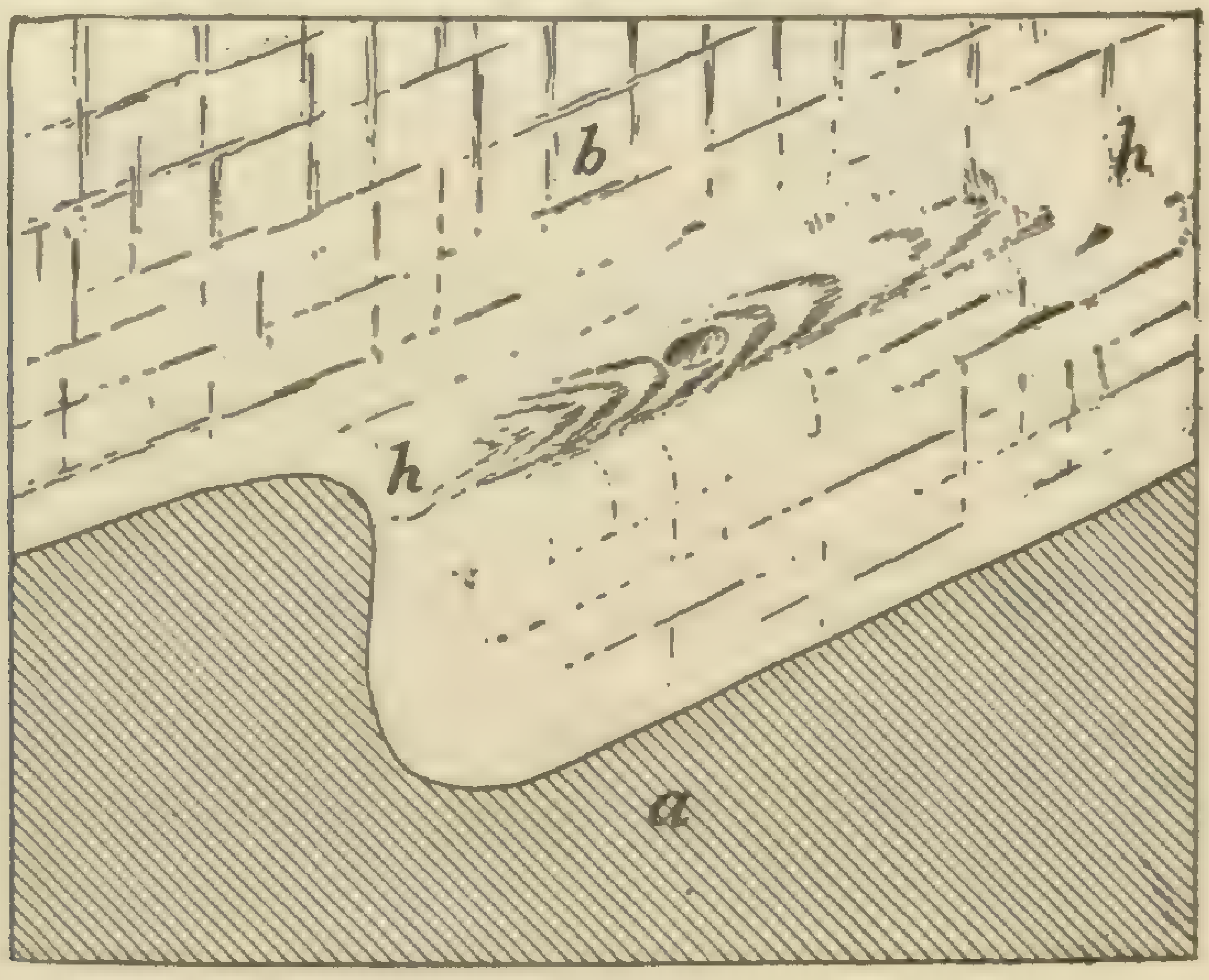

FIG. 4.—Section at Fondalsbræen, *hh*, zone along which ice (*b*) is flowing upon its lower layers.

smooth, but are as rough and as much weather-worn as similar rocks in warmer countries where no glaciers have been. Upon these surfaces, it is often difficult to discover scratches—even when present—for they are often so faint as to be only rendered apparent by moistening the rock. Even the face of the hummocks are commonly imperfectly polished. In other places, particularly at Tunsbergdalbræen which contains much sand along the margin, the rocks are highly polished, and but little scratched. One is everywhere surprised to find beneath the glaciers the great paucity of glaciated stones, and in many terminal moraines they are scarcely, if at all, to be found.

The insufficiency of glaciers to act as great erosive agents is

farther shown at Fondalen (Fig. 4), where a mass of ice thirty or forty feet thick abuts against a somewhat steep ridge of a rock, ten feet or less in height. In place of a stone-shod glacier sliding up and over the barrier, the lower part of the ice appears stationary, or else is moving around the barrier, while the upper strata bends and flows over the lower layers of ice (along the line *hh*, Fig. 4).

When the barrier to the advance of a glacier is met with, whether composed of hard rock, or of morainic matter, the ice, provided it be sufficiently high, flows over upon itself, yet when the sheet is no higher than the barrier, the lateral thrust may push it up somewhat. The best example of the consequences of such a condition is

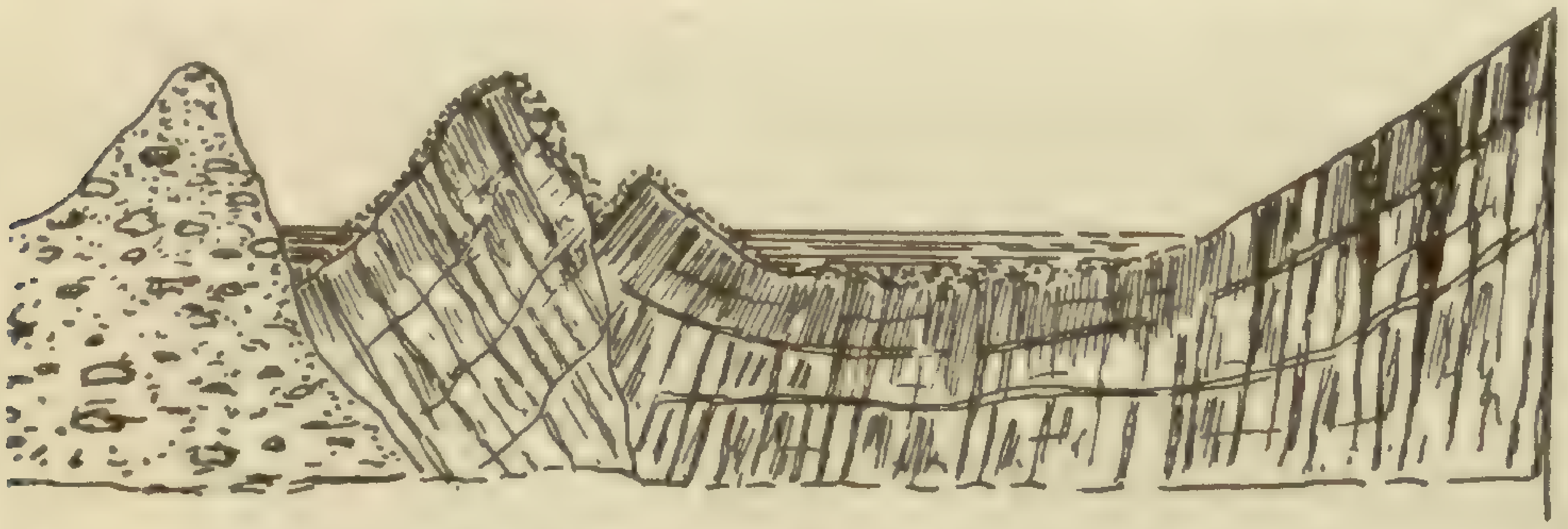

FIG. 5.—End of Svartisen glacier at head of Holandsfjord, moving through a lake against morainic barrier.

to be seen at Svartisen glacier (Fig. 5), at the head of Holandsfjord, which descends to within sixty feet of the sea, where it ends in a morainic lake of considerable size, the northern side of which is filled with the glacier. The water of the lake rises, in part, to the level of the ice, or over it, where the waves of the lake are depositing sand upon its surface. Part of the ice is not less than twenty-five feet thick, and most of it is probably double that thickness. Some of the strata of ice are pushed up and rest at 5° from the horizontal. But the interesting points are at the end of the glacier, where it impinges against the morainic barrier. Being unable to advance, the lateral pressure has forced up an anticlinal ridge or rather dome in the ice, to a height of fifteen feet, along whose axis there has been a fracture and fault. Upon this uplifted dome rests the undisturbed sand stratified in perfect conformity to the surface, which was formerly just below the level of the lake. As the ice about the line of fracture melts, the sand falls over and leaves a sand cone, of which there were examples—one at the end of the lake, and two in the centre—but the nuclei of the mounds were of

solid ice. By this lifting process, pockets of loose clayey sand were thrown on top of the morainic matter, producing thus the appearance of having been ploughed up by the glacier to even several yards beyond its termination, which has not been the case.

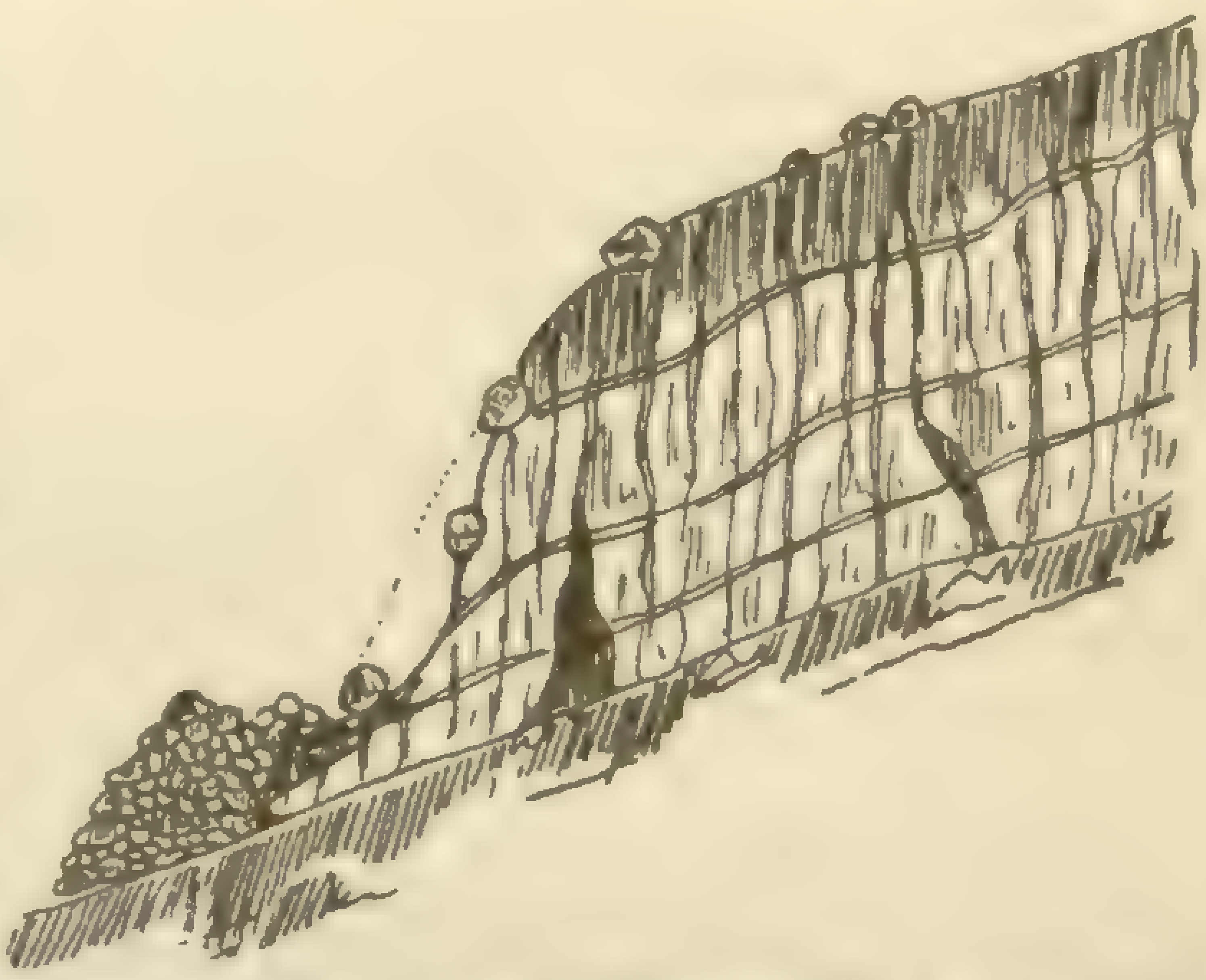

FIG. 6.—Buarbræen depositing morainic material upon a tongue of its ice, giving the false appearance of a glacial plough.

Nowhere is there apparently more ploughing action, and yet little or none to be seen, than at Buarbræ, which is advancing rapidly against a high lateral moraine. There is a large ridge (Fig. 6) of stone upon a thin snout of the glacier, just as if the ice were pushing under the boulders of earth. The glacier has a steep convex margin, from twenty to forty feet high, with many blocks and boulders upon it. These become detached, and, rolling down upon the lower tongues of ice, build up a ridge and leave a deep trough between it and the side of the glacier, and delay the melting of the layer of ice beneath, which is too thin to do any ploughing up of the moraine.

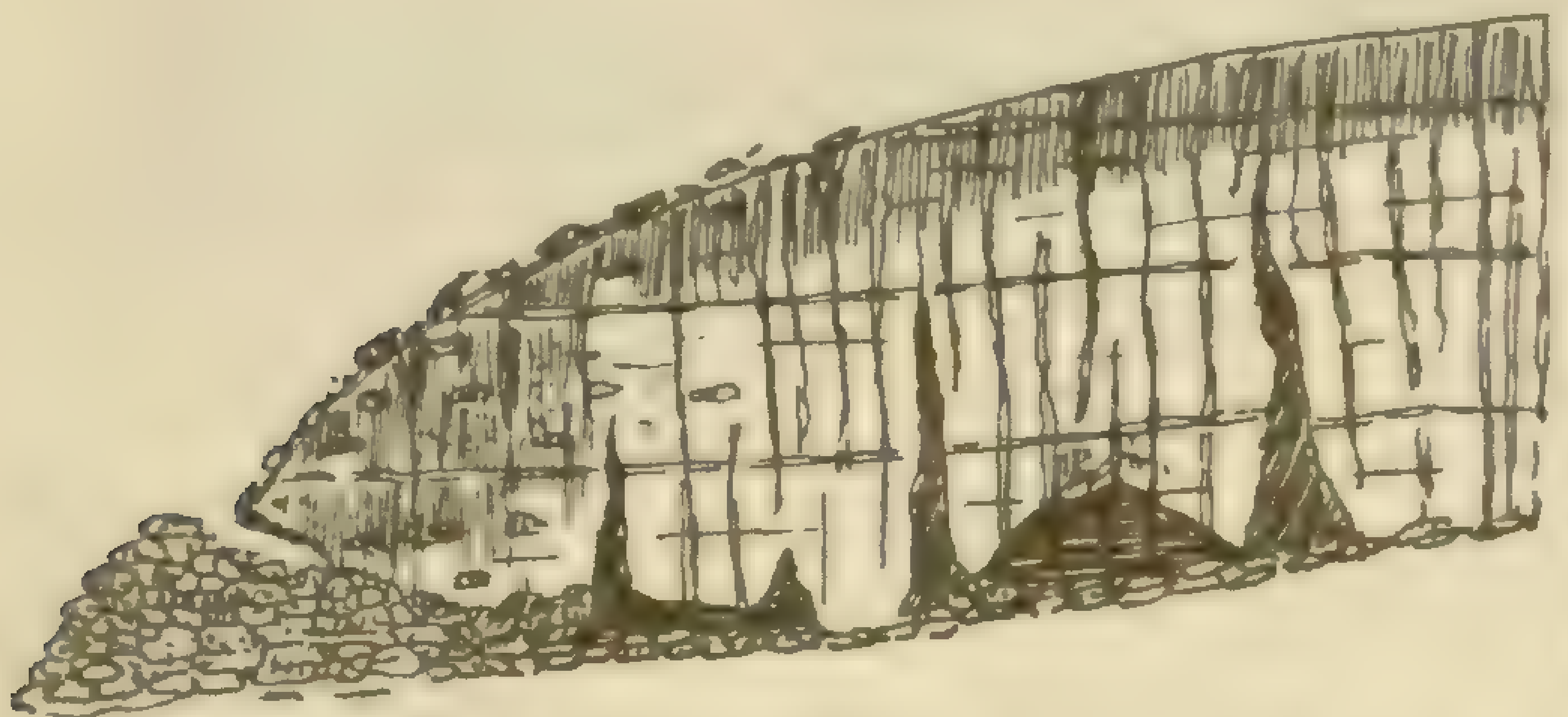

FIG. 7.—End of Suphellebræen advancing over a moraine.

An excellent illustration of a glacier advancing, without any ploughing action, over a moraine, and at the same time levelling it into a sort of ground moraine, was seen at Suphellebræen (Fig. 7). Here the glacier was moving up the slight elevation of a moraine produced by the early summer retreat of the glacier, although again advancing in July. The lower surfaces of the ice-tongue were furrowed by the loose stones of the soft incoherent water-soaked moraine, into which one's foot would sink when stepping upon it. The moraine was being levelled by the constant dripping of the water from the whole under-surface of the advancing glacier.

The glacier of Suphelle is the most remarkable of its kind, being a gigantic *glacier rémanié.* From the Jostedalsfond, which, near

the head of the valley of Fjærland fjord, is 3,000 to 4,000 feet high, the clear, bluish ice falls over a precipice of dark rocks for about 1,000 feet, and at about 1,500 or 2,000 feet above the sea begins to re-form into a glacier extending down into and nearly across the valley of Fjærland for a distance of somewhat less than a mile, to a level of only 175 feet above the sea. The glacier is much crevassed, and covered and filled with debris. In fact, it was the most dirt-laden glacier seen—not excepting the Aar glacier in the Alps. This material is wholly derived from the side of the mountain, and is brought down by frosts, and more largely by the fall of ice as it dashes from one frost-cracked rock to another. One of these great ice-avalanches I witnessed from the other side of the valley, fully a mile distant. Thousands of tons must have fallen at this time, but as the ice fell from rock to rock, it was converted into what, seen at the distance, appeared to be white dust. There are no considerable streams from the upper glacier, but from the rapidly melting glacier below the fall the volume of water laden with mud is large. As this glacier is not ploughing up, but levelling down the inequalities of its bed of loose material, we cannot suppose that the mud comes from any other than the dirt upon and within the ice, and that obtained by the dripping water as it levels the terminal moraine. This is only one of the examples everywhere to be seen showing the erroneous estimate of glacier-erosion, when based upon the amount of mud carried down by the streams flowing from the glaciers; for the debris is brought upon their surfaces by other than grinding action, and, as far as observation goes, it is not derived from beneath them, at least, to any great extent.

Although I have seen some of the sharp angles of the rocks at 2,000 feet above the fjords along the sides of the valleys, somewhat rounded and scratched, yet the inequalities of the faces have not been removed by erosion of any kind. At numerous places in Norway, as well as in other countries, hummocks of rock rise above or out of the glaciers, as the ice flows around them at lower levels, these channels having been deepened, not by glaciers, but by sub glacial streams.

Nowhere are the *roches moutonnées* so abundant as on the coast of Norway. In their more perfect form, they are not extensively developed along the coast at more than 250 feet above the sea. A

higher altitudes they are best seen about glacier-falls, farther up the valleys. But during the Pleistocene days, the coast has been raised several hundred feet, at least. The form of the hummocks is precisely like what may be seen in southeastern Missouri and other States south of the line of northern drift, or are described as occurring in Ceylon, Brazil and other tropical countries, to which only are added the scratches. The forms of these hummocks must be principally attributed to the atmospheric erosion of the crystalline rocks where the debris has been swept away by currents or by ice. We see them more frequently swept clean upon the coasts of either cold or warm countries than in the interior, where the currents are only those from rain or local glaciers, for even the sweeping beneath the glaciers is principally effected by dripping waters or streams. Professor Kjerulf, of the University of Christiania, than whom there is no better authority, regards the production of hummocks and their glaciation up to a height of 600 feet upon the coast of Norway, as the result of floating ice.[1]

The absence of transported boulders and striations upon the surface of many parts of the high plateaus of Norway is doubtless, in part, attributable to the ability of ice to flow around loose obstacles, and the frequent want of higher ridges to furnish material by their debris falling upon the ice to work through the mass afterwards.

The faith in glaciers, as great erosive agents, has been so severely shaken that few geologists, who personally study those still existing, now attribute to them greater power than that of removing soft materials, and of this power many others are sceptical, *e.g.*, Professor Penck,[2] of the University of Vienna, who has been misquoted as having proved their great efficiency in eroding basins in hard rocks. To this scepticism, it seems to me that these notes must contribute; especially when glacial erosion is applied to the hypothetical excavation or modification of great lake-basins, and the transportation of the northern materials in the boulder clay over the broad plains of America, as there were no mountains of adequate height with peaks, or *séracs*, to supply the detritus sufficient to furnish the tops of the glaciers with all the boreal material of the drift, which "covers half a continent."

[1] Discourse before Meeting of Scandinavian Naturalists, Copenhagen, 1873.

[2] Geological Magazine, April, 1883.

In connection with this paper, the observations of Herr Payer and other arctic explorers are important. The snow-line of Franz Joseph Land descends to within a thousand feet of the sea, and the numerous glaciers discharge great quantities of icebergs as they move down into the ocean. Payer says: "However diligently I look for them, I never saw unmistakable traces of grinding and polishing of rocks by glacier-action."[1]

Lieutenant Lockwood[2] found in central Grinnell Land a thick ice-cap, extending for a distance of from seventy to ninety miles, faced by an ice-wall of from 125 to 200 feet high, irrespective of topographical inequalities. It was free from rock debris, except in a valley confined by mountain-walls thousands of feet high. Along its foot there was almost an absence of morainic deposits, and even where present these were unimportant ridges. The general absence of rock and dirt in the arctic glaciers is a common subject of remark. The snow line in the high latitude of central Grinnell Land is 3,800 feet above the sea, and the glaciation of the rock about the adjacent Lake Hazen (500 feet above tide) is not recent.

In Spitzbergen, where the snow-line is much higher, striated rocks, according to Nordenksjold, occur only below 1,000 feet.[3] The same holds true for Labrador, where the scratches are confined to the lower thousand feet, although the mountains rise to 6,000 (Bell).[4]

In the Antarctic regions, the officers of the "Challenger" remarked the absence of detritus in the icebergs and southern ice, although Wilkes and Ross saw rocks upon a few bergs. These last are supposed to have come from valleys in the volcanic mountains.

Indeed, outside of valleys, explorers in high latitudes have not found, in the margins of such ice-caps visited, the tools capable of great erosion. The continental area of North America presents very much lower and less abrupt prominences than the reliefs of Greenland, Grinnell Land, Spitzbergen or Franz Joseph Land. Overhanging mountains seem to be necessary to supply glaciers with tools by which alone any abrasions can be accomplished, and

[1] New Lands within the Arctic Circle, 1872-74.
[2] Three Years of Arctic Service, 1881-4, Greely.
[3] See Geological Magazine, 1876.
[4] Dr. Robert Bell, in Hudson's Bay Expedition of 1884.

these conditions belong only to valleys of great mountain ranges. However, there is one condition under which glaciers, when shod with graving tools, ought to be great eroders, viz., when their motion is much more rapid than the flow of land ice,—which is almost invariably less than three feet a day, under which condition, included stones commonly adhere by friction to the subjacent rocks, and cause the lower surfaces of the ice to be grooved. This condition of extraordinarily rapid movement has been seen at Jacobshavn glacier in Greenland, where Professor Helland [1] found a velocity of from forty to sixty feet a day. In Alaska, Lieutenant Schwatka [2] and Professor G. F. Wright [3] observed glacier movements of from forty to seventy feet a day. In these cases the glaciers are moving into the sea, and the new element of partial flotation or sliding, which does not belong to land glaciers, is here introduced. The great velocity of these glaciers is far beyond any observed ability of ice to flow as plastic bodies; consequently, one is led to conclude that, under partial flotation, stones may be held firmly as graving tools by glaciers.

Hereby we are able to explain the occurrence, in many Alpine valleys, of a greater glaciation than we see in progress to-day, as being due to glaciers rapidly advancing into fjords, during a period of partial submergence.

The appeal to the greater magnitude of the glaciers, as producing effects not now seen as the result of those of the present day, seems to be begging the question, for the action of thicker glaciers differs from that of thinner in amount rather than in kind; for increased pressure, raising the temperature, increases the plasticity of the ice, as it is seldom if ever lower than freezing point. Consequently it seems improbable that stones should be held more firmly in glaciers of thousands of feet in thickness than in those of hundreds of feet. In addition, the friction between the stones held in the ice, and the surface of the subjacent rock, is proportionally increased by the greater weight of the glacier.

Over the vast area of action, the work of floating or sea-ice, in some forms, is enormous. On the northern side of Hudson Strait,

[1] Ice-fjords of North Greenland, Quart. Jour. Geo. Soc., 1877, A. Helland.

[2] "Times" Alaska Expedition, New York, 1886, Schwatka.

[3] The Muir Glacier, Am. Jour. of Sci., 1887.

Dr. John Rae,[1] who had very extensive arctic experiences, found that snow drifting over precipices into the sea resulted in the formation of bergs, sometimes a hundred feet thick, filled with the loose rock debris of the coast, and having the form of the shore where formed. Most of them break loose and drift away to melt or become stranded elsewhere.

Greely describes the great momentum with which the floe-bergs come together. By their meeting the ice is crushed, and raised up into ridges fifty or sixty feet high.

One cannot read carefully the results of the British Arctic Expedition of 1875–6 without being impressed with the erosive power of drifting ice, moving with a velocity never acquired by glaciers. Floe-bergs are pushed upon a shelving sea-bottom, until the ice has risen from twenty to sixty feet, after their first stranding in perhaps only from eight to twelve fathoms of water, although weighing tens of thousands of tons.[2]

As the grounded floe-bergs are forced up the shelving sea-bottoms, ridges of earth and stones are pushed up in front of them. Floe-bergs which have been toppled over, thus showing their original bottoms, and also masses of pushed-up coast ice are found to be grooved and to contain angular stones with their exposed surfaces scratched and polished. As the movement is greater than the velocity of glaciers flowing about obstacles, it is only natural to expect that the enclosed stones should be held firmly as graving tools, or be wrenched out owing to the brittleness of the ice under such great stress.

In describing the ice action on the coast of Labrador, Professor H. Y. Hind says the "pan-ice" (from five to twelve feet thick) is polishing the surfaces and sides of the rocky coast, and producing boulder clay. He says: "When the pans are pressed on the coast by winds, they accommodate themselves to all the sinuosities of the shore line, and being pushed by the unfailing arctic current, which brings down a constant supply of floe ice, the pans rise over all the low lying parts of the Islands, grinding and polishing exposed shores, and rasping those that are steep-to. The pans are shoved over the flat surfaces of the Islands, and remove with irresistible force every obstacle which opposes their thrust, for the

[1] In Canadian Journal, Toronto, 1859.

[2] British Arctic Expedition of 1875–76, Sir George Nares.

attacks are constantly renewed by the ceaseless ice stream from the northwest, and this goes on uninterruptedly for a month or more."[1] Similar results elsewhere have been frequently recorded, as those of Professor Milne in Newfoundland.[2]

While the power of glaciers, under favorable conditions, to abrade and scratch rock surfaces, as "sand-paper" scratches "a cabinet," is not questioned; yet these observations, in Norway and elsewhere in high latitudes, all confirm the correctness of the verdict given by many geologists—especially in Europe—who have had the opportunity of personally studying living glaciers, that the potency of land-glaciers to act as great eroding agents, capable of "planing down half a continent," or ploughing out great valleys, or lake-basins, or even of greatly modifying them, is not only not proved, but most strongly negatived. Even the power of glaciers to abrade is reduced in many cases almost to zero.

EDITORS' TABLE.

EDITORS: E. D. COPE AND J. S. KINGSLEY.

European governments give more attention to the preservation of their ancient and prehistoric monuments than does the United States. This may arise, partly, from the increased interest upon that subject among their officials and people; or, partly, from the differences in our form of government. Whatever may be the cause, our government and our people, unless they improve their present methods in this direction, will find cause for regret in after years, when the prehistoric monuments of our country shall have been destroyed and their contents scattered without a record, when it will be too late to remedy the neglect.

The French government has passed several laws upon this subject. It has established a commission under the direction of the Minister of Public Instruction and Fine Arts, charged with the duty of the supervision of these monuments throughout the Republic. These laws only provided for the procuration of the title to land by gift or purchase. Some of the land-holders took

[1] Notes on Some Geological Features of the Northeastern Coast of Labrador, Can. Nat. 1878.
[2] Ice and Ice Action, Newfoundland, Geol. Mag., 1876.

advantage of this and increased their price beyond what was fair and reasonable, and now the French government has met them with a decree, authorizing the State to acquire by *expropriation* the land on which these monuments are situated, principally in the Commune of Carnac, Department of Morlehan.

Many of the monuments have already been acquired; have been restored to their original condition, surrounded by a fence, where practicable, for the necessary preservation. This has been done under the supervision of M. Felix Gaillard, archæologist of Plouharnel.

Those to be added under the decree, above mentioned, will be the great alignments of Menec, of Kermario and of Kerlescan; the great tumulus of Saint-Michel, that of Moustier, of Crucuny and of Kerlescan. Also six Menhirs and six Dolmens.

It is believed that under the operation of this law the present proprietors will yield, and that the State will acquire, by purchase, all the monuments of this kind within the commune. When these are restored and put in proper condition, this commune will be one of the most attractive in all France, and the American tourist, interested in prehistoric archæology, will feel it as much a necessity to visit it as to visit Paris.—*T. W.*

RECENT LITERATURE.

A Review of Mr. Lydekker's Arrangement of the Mesozoic Mammalia (Cat. Foss. Mamm., British Museum, Part V., 1887).—Mr. Lydekker places all the Mesozoic mammalia among the Marsupialia, not admitting that there is sufficient weight in the close analogy between the dentition of the Stylodontidæ and Chrysochloridæ to support a reference of this family to the Insectivora. The genera included under the sub-order Multituberculata of Cope are provisionally embraced in the Diprotodontia (p. 195,) while all the remaining forms with numerous small incisors are placed with the Polyprotodontia. I agree with the author that the systematic position of the Multituberculata forms, such as Plagiaulax, Tritylodon and Polymastodon must be left, in a measure, provisional until additional material is obtained; but at present, in my opinion, the balance of evidence necessitates their separation from the Diprotodonts. The most striking feature of both these groups is the hypertrophy of a pair of incisors in each jaw; but, so far as a close comparison of these incisors in the fossil and recent forms is

possible, it supports the conjecture that these teeth in the two groups *are neither homologous nor homodynamous*, although bearing a superficial analogy.[1]

(1.) As regards homology, in all the Quaternary and recent Diprodonts it is the median incisor which is hypertrophied; whereas, in the Mesozoic genera—in which the mode of reduction has been observed—the second incisor, or, rather, one of the lateral incisors is hypertrophied. In the Bolodontidæ, as demonstrated by Marsh in his observations upon *Allodon*, the median incisor is reduced and the *second* incisor is hypertrophied. In *Tritylodont* there are two incisors: the outermost is close to the maxillary suture; the hypertrophied incisor is close in front of this and widely separate from its opposite fellow, indicating that if this genus is descended from a form with three or four incisors (as a comparison with Bolodon renders probable), it is again the median incisor which has disappeared. We have no further evidence bearing upon this point, so it will be of importance to observe which of the incisors is hypertrophied in *Plagiaulax*.[2]

(2.) *As regards homodynamy*, another characteristic which appears to be universal among the Multiberculates is the fore-and-aft grinding motion between the alternating rows of tubercles upon the upper and lower molars. This is very marked in *Bolodon* and *Tritylodon*; it is in a transition stage from a fore-and-aft to a circular grinding motion in *Polymastodon*; it is very evident in the later Plagiaulacidæ. Professor Marsh recently called my attention to the wearing of the posterior face of the large upper incisor of *Allodon* by the tip of the lower tooth. This interference forces the jaw backwards as it ascends by a mechanism similar to that in the rodents, as demonstrated by Cope.[3] It has effected a rapid reduction of the other incisors, as witnessed in *Tritylodon* and *Bolodon*; a total reduction, as witnessed in *Polymastodon* and *Plagiaulax*. In contrast with these genera, the recent Diprotodonts present, for the most part, three upper incisors; while the reduction of all, except the median incisors and the fore-and-aft grinding motion, is confined to a single family, the Phascolomyidæ.

(3.) The longitudinal arrangement of the conical tubercles in two or more rows is peculiar to the Multituberculates, and, according to Cope, forms a sufficiently clear sub-ordinal distinction.[4]

The technical question of taxonomic position is, however, of minor

[1] In the Postscript, p. xv., by a slight oversight, the author refers to *Spalacotherium*, instead of *Stylodon*, as having been compared by Osborn with *Chrysochloris*. (See Osborn, Proc. Phila. Acad. 1887.)

[2] Mr. Lydekker mentions (p. 195, footnote) that Lemoine describes two incisors and a canine in the maxillary series of *Plagiaulax*. I have not come across this description.

[3] The Mechanical Causes of the Origin of the Dentition of the Rodentia. American Naturalist, January, 1888, p. 12.

[4] The Tertiary Marsupialia. American Naturalist, 1884, p. 188.

interest. The chief point is the question of phylogeny. In my opinion, the Multituberculata will finally prove entirely distinct from the Diprotodonts and representative of a phylum of genera which reached too great a degree of specialization at the close of the Cretaceous to survive until the recent period. *Thylacoleo* was placed as the latest representative of the Plagiaulax line by Owen, and, later, by Cope; but this view is not shared by Lydekker, who places it near the Phalangistidæ. (Op. cit., p. 188.)

The family arrangement is the same as that proposed by Cope and adopted by myself,[1] with the addition of the Bolodontidæ. We are surprised to find *Microlestes* placed in the latter family instead of in the Plagiaulacidæ; for the type-molars bear only a superficial resemblance to those of *Bolodon*, and closely approach those of *Plagiaulax*.

The Polyprotodont genera are provisionally placed by Lydekker in five distinct families, under the Marsupialia Polyprotodontia. In the arrangement of these genera the author has been at a great disadvantage in not having been able to study the types of the Yale College collection, in which the molars are exposed upon both the inner and outer surfaces, and thus fails to recognize the distinctive features of the molars in many instances. But this will not explain his separation of *Amphilestes* and *Phascolotherium* from the Triconodon line and their union with such diverse forms as *Amphitherium*, *Achyrodon* and *Peramus*.

(1.) In the Amphitheriidæ (which embraces, among others, the five genera just mentioned) we are surprised to find (p. 274) that *Peraspalax* is made a synonym of *Amblotherium*. This is explained in a footnote (p. 274), in which a small inner cusp is described upon the lower molars of *A. soricinum*—an interesting observation if correct, because it is entirely opposed to the observations of Owen (Mesozoic Mammalia, 1871) and the writer (1886). According to the latter, *Peraspalax* has prominent internal cusps, separate from the internal—a type of molar found only in the type maxilla of *Peralestes*. The lower jaw of *Peralestes*, type of *Phascolestes* (Owen), is also united with *Amblotherium*. This is more probable, as the outer face of neither genus is certainly known, and the inner faces are very similar; but if *Amblotherium* and *Phascolestes* are alike, both must be removed with *Achyrodon* to the Stylodontidæ.

This turns upon the observations of Owen of impressions of styloid external cusps of the *Phascolestes* molars, which is not confirmed by Lydekker (p. 276), although in *Dryolestes vorax*,[2] Marsh, we have a jaw and dentition closely similar to that of this genus, with styloid external molar cusps. *Amblotherium* and *Achyrodon* have a much more delicate dentition than *Phascolestes;* but the writer anticipates

[1] On the Structure and Classification of the Mesozoic Mammalia. Abstract, Proc. Phila. Acad., June, 1887.

[2] Am. Jour. Sc. and Arts, April, 1887.

that when the outer faces of the lower molars are known they will also prove to be of the *Stylodon* type.[1] The Amphitheriidæ is thus made a miscellaneous family, to embrace genera with lower molars —"multicuspidate, tricuspidate, or differentiated into a blade and talon." "The difference in the character of the lower molars is not greater than obtaining in the Dasyuridæ" (p. 269).

While this may be true, it does not afford sufficient ground for separating *Phascolotherium* and *Amphilestes* from genera with three-lobed molars (*Triconodon*) and placing them with genera with two-lobed molars (*Amphitherium* and *Peramus*). The American genus *Dromatherium*, with unpaired fangs, is also placed in this family, adding to its heterogeneous character.

(2.) Triconodontidæ, *Triconodon*, probably by a typographical error, is stated to have no internal cingulum upon its molars (p. 257). The cingulum is one of the most characteristic features of the molars, and establishes the close homology which exists between the *Triconodon*, *Phascolotherium*, *Amphilestes* and *Spalacotherium* molars, indicating their phylogenetic relation with many mandibular and dental characters in common, that they formed a series of primitive Carnivora. Lydekker follows Marsh[6] and Osborn[5] in making *Spalacotherium* the type of a distinct family, the (3) *Spalacotheriidæ*. The inward rotation of the lateral cusps characteristic of this genus is begun in *Phascolotherium* and extended in *Tinodon*, affording transitions; so that, with the resemblances of the mandible and premolars, it is probable that this genus is an offshoot of the *Triconodon* type. At all events, I cannot now discover family characters sufficient to separate it from the Triconodontidæ. I cannot share the opinion (p. 292) that these molars are of the *Chrysochloris* type; they are rather of a primitive tubercular, sectorial order, leading to the sectorial triangle of the *Didelphys* molar. Upon page 294 we find *Peralestes* (type maxilla, Owen) also placed in this family, and doubtfully separated as a genus from *S. tricuspidens*. The molars of this genus, with separate external and internal cusps, are widely different from those of *Spalacotherium*, the upper molars of which will probably be found to exactly reverse the pattern of the lower. This genus seems, therefore, to be identical with Peraspalax.

(4.) It is in *Stylodon*, type of the Stylodontidæ, that we find the real homologue of the *Chrysochloris* molar[5] and a representative of a true line of Insectivora. Lydekker, although in possession of Marsh's description of the lower molars of the closely allied genus *Dryolestes*, describes the lower molars of the Stylodontidæ as simply conical (p. 290). We have positively no grounds for referring this

[1] In fact, it is probable that several specimens which were referred to *Amblotherium* by Owen really belong to *Stylodon*—*e.g.*, *A. mustelula* (Plate II., Fig. 2, Owen's Memoirs). The mandibular and premolar structure of this genus and *Achyrodon* is very similar to some of the *Trylodontidæ*. See *Achynodon Names*, Owen, Plate II., Fig. 7.

family to the Marsupialia. No Marsupial presents an analogous dentition. *Perameles*, it is true, bears a similar relation to *Tupaia*; but some stress may be laid upon the fact that the *Stylodon* and *Chrysochloris* are the only known examples of this type of molar.

As Mr. Lydekker himself indicates by his frequent use of the word *provisional*, we are certainly not in a position to reach final conclusions in regard to the classification of the greater number of these Mesozoic genera; and this review of the related portion of this valuable catalogue is intended, in large part, to suggest further inquiry, rather than as an expression of final opinion on my own part. —*Henry F. Osborn.*

SEEBOHM ON THE CHARADRIIDÆ.[1]—This is another of the handsomely illustrated works of large folio with which the ornithologists of Britain from time to time delight the scientific world, and all other lovers of nature as well. While the present publication does not pretend to be a complete descriptive monograph, diagnostic characters and figures of species and sub-species are given, which are quite sufficient for the determination of the known members, at least, of the family. The scope of the work is indicated by the fact that it embraces as Charadriidæ the tribe Limicalæ of many authors. Especial attention is given, as the title indicates, to the geographical distribution of the members of the family, with especial reference to their evolution.

The first chapter is occupied with the classification of birds in general. The second is devoted to evolution in general. The author here distinctly affirms the doctrine that Natural Selection never originated anything, and he ranges himself on the side of the Neolamarckian school, although he does not say so in precise terms. In this matter he shows himself to be much more perspicacious than those of his countrymen who, like Mr. Romanes, regard this view of the subject as "transparently fallacious" (Romanes in review of Schurman in *Nature*, Feb., 1888). But we take issue with Mr. Seebohm in his expression of evolution in taxonomy. Like Schlosser, he believes that "natural" groups must represent phylogenetic series, and he believes these series to be expressed by the totality of the animals' characters. Thus characters of the specific grade generally in his system take precedence of those usually regarded as generic and even higher. We have objected to this doctrine on various grounds, especially in our essay on The Origin of Genera.[2] First, because generic characters probably express more in phylogeny than specific; second, because specific characters consist of an aggregate of single characters, and each has had a history independent of the others, so that

[1] The Geographical Distribution of the Charadriidæ, by Henry Seebohm. London: Henry Sothern & Co. 1887. 4to, pp. 524.

[2] Origin of the Fittest. D. Appleton & Co. 1887. Art. II.

the history of single characters, one at a time, is a history of the whole; third, because the interruptions in the geological record will always prevent us from making complete phylogenetic series, and our tangible breaks will be transverse to phylogenetic lines; and it is on these breaks that the system will ever depend. Such a system may be called artificial, but it is the only system with definitions that we can ever have. As a consequence of his views on this subject, Mr. Seebohm combines species with three toes in the same genus as those with four, and species with an expanded bill (Eurynorhynchus) with species without such expansion (Tringa).

Like most American zoologists, Mr. Seebohm finds it necessary to adopt sub-specific names, or the trinomial system, for protean groups. In this way the relations of the forms are well expressed throughout this work.

We wonder when the wealthier men of the United States will begin to devote some of their spare time and means to the production of works like this admirable combination of science and art. —*E. D. C.*

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GENERAL NOTES.

GEOGRAPHY AND TRAVEL.[1]

Asia, Etc.—North Borneo.—The account of explorations in North Borneo, by D. D. Daly, published, with map, in the Proceedings of the Royal Geographical Society (January, 1888), is a valuable addition to current knowledge of the great island, a large portion of which has recently fallen under British rule. The most southerly point of British North Borneo is 3° 52′ N.; the most northerly (the northern point of Banguey Island), 7° 25′ N.; the most westerly, 115° 20′ E.; the most easterly, 119° 16′ E. The area is computed at 31,000 square miles, the seaboard at 700 miles, and the population at 150,000. The principle land-locked

[1] Edited by W. N. Lockington, Philadelphia, Pa.

harbors are Gaya, on the northwest coast; Kudat, on the west side of Marudu Bay, at the northern extremity of Borneo; and Sandakan, on the northeast coast. The town of Sandakan, 1000 miles from Singapore, is the seat of Government. The country is divided into the provinces of Keppel, Alcock, Dent and East Coast. Sandakan is on the north side of the harbor, at the base of some steep cliffs, is remarkably healthy, and has a population of about 3000 Chinese, 600 Malays, 300 Sulus, 500 natives and others, and 30 Europeans. Hardly any trouble has been experienced with the natives. The British North Borneo Company was chartered November 1, 1881. Tobacco is the principal crop yet cultivated, and Chinese contract labor furnishes the means, for the climate is not one in which the white man can perform hard work in the open air. The larger half of the island belongs to the Dutch, who are not taking steps to encourage the opening up of their territory. The remainder consists of British North Borneo, Sarawak, and the small independent sultanate of Brunei.

Mr. Daly (August, 1884) entered the Kinabatangan, the largest navigable river of the territory, in a steam-launch. Malapi, about half a degree up this river, is the depot for the edible birds' nests brought from the Gomanton caves, about twelve miles farther north. The value of the nests collected is $25,000 per annum. The height of one of the vaults of these caves has been estimated at 900 feet, and a steady column of Collocalias has been seen to fly from one of the apertures for forty-five minutes. All the birds' nests caves (there are many others) are in isolated mountains of limestone in a country of secondary formation. The settlements along this river and its tributary, the Lokan, which rises near Mount Kinabalu (13,680 feet), seem to be flourishing, durians, langsat, rambutans, mangoes, limes, oranges, lichee and pulasans being among the fruits cultivated. Penungah, still higher up the main river, is a police station, with Sarawak Dyak constables, and its establishment has brought peace among the Tungara, Romanow, and Tambanuah tribes of the vicinity. Several rivers unite near Penungah, all run in gorges between jungle-covered ranges from 2000 to 6000 feet in height, and in the rainy season the waters have been known to lap the foundations of the police station, seventy feet above the river at its usual level.

The Padas river, also ascended by Mr. Daly, is the chief artery of the eastern Province Dent. Its embouchure is a great delta opposite Labuan. The lower course has prosperous settlements of Besayahs, Dusun, etc., with sago-palm plantations and paddy fields. Higher up live the Muruts, who wear no clothes, and are still, where not yet reached by British influence, addicted to head-hunting. The Murut Chief Żalmiboh put his house at Mr. Daly's disposal. It was fifty feet square, and very clean; but from the rafters dangled fifty human heads and pieces of human bones.

Mr. Daly was himself instrumental in making the Muruts and the Peluans of the interior swear to be at peace with each other, and to follow the law of the British North Borneo Company, beneath whose flag they swore friendship.

The Zones of Tibet. — General S. T. Walker, after the reading of Mr. Carey's account of his travels in Central Asia, before the Royal Geographical Society, stated that Tibet might be broadly divided into three zones, which increase in altitude from south to north; a southern zone, 10,000 to 12,000 feet above the sea, containing L'hasa and all the towns and villages of the settled population; a middle zone, 12,000 to 14,500 feet high, comprising the pasture lands of the nomad Bodpas, or pure Tibetans; and a northern zone, 14,000 to 17,500 feet above the sea, partly occupied at certain seasons by Turkic and Mongolian nomads, but mostly abandoned to wild animals. It was this Chang-Tang or northern plain that Mr. Carey had crossed in various parts during his journey to and from Turkestan.

Africa. — Lake Shirwa. — According to the Rev. A. Hetherwick, there is now no communication between Lake Shirwa, or Chirwa and the Lujenda River. It is very evident that at one time Lake Shirwa covered the broad flat plain to the west of it, and was united to Lake Chinta, the present head of the Lujenda. Gradually the waters fell, and the sandy ridge of Chezomoni appeared. The present lake is very shallow, and grows smaller yearly. Its area is about 350 square miles.

Sete Kama. — Sete Kama, on the west coast of Africa, is the name given to the district extending from 2° 28′ to 2° 45′ south latitude. European factories are scattered along the beach for about three miles. All the factories have sub-stations on the Ndago lagoon, the old mouth of which has been silted up for three years. It appears that the land is gaining on the sea, for at Ngoné, a mile from the shore, Mr. Walker found an old ship's anchor. Ndago lagoon is of great extent. The Balombo, who inhabit Sete Kama, have a week of four days, as do also some other tribes on the west coast.

Geographical News. — King Menelik of Shoa has recently annexed Harar, not many years since a part of the Egyptian possessions. The French traveller Rimbaud has returned to the coast from Shoa *via* Harar, thus avoiding the dangerous route through the Danakff country. The distance between Antotto and Harar is 310 miles.

Manitoba has been reduced in area from 123,200 square miles to 60,250, the remainder having been added to Ontario and to the district of Keewatin. The population of the reduced area has risen in five years from 62,260 to 108,640.

GEOLOGY AND PALÆONTOLOGY.

Mimic Earthquake Near Akron, O.—A district of country lying about five miles south of Akron, O., was on the night between Thursday, February 9th, and Friday, February 10th, the scene of a commotion that well simulated an earthquake on a small scale. About nine o'clock in the evening a smart shock disturbed the inhabitants and caused much consternation, which was intensified when between two and three the following morning a severer one, accompanied by a loud noise, as of an explosion, awoke the sleepers by shaking the houses and cracking the walls of some of them. When daylight came several long clefts in the ground were discovered, furnishing evidence of some subterranean disturbance during the night.

Similar phenomena occurred almost in the same spot in 1882 and 1883. At that time a cleft from two hundred to three hundred feet long was formed, which crossed a road, marking its course with a furrow, such as that made by a plough. This crack was not more than an inch or two in width, but was sounded with a stick to the depth of several feet (some say fifteen or twenty). It passed under a house, cracking the cellar-wall. The noise accompanying it was likened by some of those who heard it to a cannon fired in the cellar. The explosion of Friday morning last (February 10) was heard by several persons in Akron, at a distance of about five miles.

The writer visited the spot last summer, at the request of a gentleman who had leased several farms, with the intention of drilling for gas. On making inquiry of one of the oldest residents, he learned that an earlier event of the same kind took place about twenty-five years ago, but could get no details.

The phenomena pointed, not to seismic causes, but to subterranean explosions, presumably of gas. The ground is clay and gravel, moraine matter, probably not less than a hundred feet in depth.

Another account differs somewhat in the details: "After the explosion in 1882, then the fissures, some of them nearly half a mile long, radiated to the top of a rise of ground. Mr. Thornton dug a hole nine (9) feet deep at the point where the fissures crossed or formed a centre, and at that depth found the cleft in the earth as pronounced as it was at the surface."

So far as it is possible to determine it, the cause of the commotion is due to the presence of a certain, perhaps a small, amount of natural gas, which, in ordinary circumstances, escapes unnoticed. But when the ground is frozen (and all these explosions have occurred in the winter) the gas is unable to ooze through the soil and

accumulates below the frozen crust, until its elasticity becomes sufficient to burst it; hence the explosion, the shock, and the cracks in the ground.

At the outburst in 1883 several of these cracks could be seen radiating from a central point in a field and extending to different distances. One of the spectators says these clefts divided the field into half or quarter-acre pieces. Similar results followed the late explosion. I have not seen the place since, but learn that the fissures very soon closed, or were filled up in consequence of a rapid thaw.

"One peculiar feature is that while former disturbances rent greater fissures and were accompanied by much greater damage to property than the recent ones, yet, so far as is known, none of the former explosions was heard or felt in this city."

It would be interesting to inquire if any similar events are on record elsewhere in regions yielding natural gas. Perhaps this note may be the means of calling out such cases if they exist.

It may at first sight appear as if so powerful explosions and shocks must indicate natural gas in considerable quantity. But when we reflect that the pressure in a well of small yield rapidly rises to a high figure when the bore-hole is closed, we see that such an inference is not safe. No other indications of gas are yet known in the immediate neighborhood, as would probably be the case if a large supply were accessible.—*E. W. Claypole.*

Geological News.—Primordial.—It is stated that vestiges of the primordial fauna, hitherto unknown in France, have been discovered by M. Bergeron in the Black mountain (la Montagne Noire) of Herault. Conocoryphe and Paradoxides are represented by fine examples.

Devonian.—Mr. A. S. Woodward (*P. Z. S.*, 1887) notes the presence of a canal-system, evidently sensory, in the shields of Pteraspidians. He believes these to represent a "lateral-line" system.

B. Stürtz (*Palæontographica*, Band 32) describes several new echinoderms from the middle strata of the Lower Devonian upon the Rhine. *Ophiurella primigenia, Furcaster palæozoicus, Bundenbachia beneckei*, and *B. grandis* are the new Ophiuroids and related forms described; the star-fishes include an Astropecten, Palastropecten and Eoluidia, a Loriolaster and a Palasteriscus.

K. A. Penecke has contributed to the Zeitschrift der Deutschen Geologischen Gessellschaft for 1887 an account of the fauna and the age of some palæozoic coral reefs in the eastern Alps.

Dr. J. Walker discusses the structure of Crinoids, with special reference to the species found in the Solenhofer slates and the

Diceras-chalk of Kelheimer, in the 32d volume of *Palæontographica.* Four plates illustrate the memoir.

Carboniferous.—Mr. Kliver describes (*Palæontographica*, Band. 32) various arthropod remains discovered in carboniferous strata of Saarbrucken and Wettin-Löbejüner. The species include an Ectoblattina, two species of Termes, a Dictyoneura, and an Acridites.

Prof. Boyd Dawkins states his conviction that the soundings for the proposed tunnel across the Straits of Dover will bring to light the existence of vast beds of coal, connected, on the one hand, with the coal measures of Belgium and the north of France, and, on the other, with those of Wales and Somersetshire (England).

Permian.—The second part of Dr. Anton Fritsch's "Fauna der Gaskohle and der Kalksteine der Perm-formation" of Bohemia, has been published. These strata rest upon Silurian rocks. The coals, clays, and ironstones have a carboniferous facies, and the conformable limestones are believed to be true Permian. "The palæontological evidence," says the reviewer in *Nature*, "is somewhat anomalous in the views of purely British fossilists, but it speaks very forcibly and in a most suggestive manner to the students of the Gondwana formation of Hindustan." Two new species of Dendrerpeton are described, and a family Dendrerpetonidæ is characterized.

M. Bayle has found two entire specimens of Gaudry's *Actinodon frossardi* in the Permian deposits at Telots. Gaudry's descriptions were based upon fragments discovered near Antun. Actinodon was probably a carnivorous reptile about $2\frac{1}{2}$ feet long, living more upon land than in the water, and formed for gliding serpentine movements. The stage of evolution presented by this reptile is comparable, according to M. Gaudry, to that of the Chelydosaurus of Bohemia, the Zygosaurus of Saxony and Russia, the Platyops of Russia, the Gondwanosaurus of Hindustan, and the Trimerorhachis and Eryops of Texas. Its scales were disposed in chevrons, its vertebræ were formed of separated pieces, and its large ribs gave attachment to ample muscles.

The internal shell of the Sepiadæ, and its relations with the Belemnites, forms the subject of an article by Dr. E. Riefstahl in Volume 32 of the *Palæontographica.*

The fossil flora of the Red Sandstone and Muschelkalk of the

neighborhood of Commern is described by Dr. Max Blackenhorn in the 32d volume of Zittel's *Palæontographica.*

Trias and Jurassic. — The German *Palæontographica* (Stuttgart, 1886) contains a geological and palæontological monograph of the "Vilser" Alps, with especial reference to the Brachiopoda. The work is illustrated with fifteen plates and a map of the region. The strata belong to the Trias and Jura. The general facies of the fauna, especially that of the Brachiopoda, is Mediterranean rather than Central European. Several new species are described.

The Asterids of the White Jura of Swabia and Franconia, with researches into the structure of the Echinodermata and the calcareous skeleton of the Asteriadæ, form the subject of the last memoir in Volume 32 of *Palæontographica.*

A new Iguanodon, *I. dawsonii*, has been described by Mr. R. Lydekker from the Wealden strata of the Isle of Wight.

G. C. Laube and G. Bruder describe the Ammonites of the Bohemian chalk in Band. 38 of *Palæontographica.* Eleven Cenomanian, twenty-five Turonian, and fifty-seven Senonian forms are enumerated, several of them new. The memoir is illustrated by six plates.

Mr. A. S. Woodward (*P. Z. S.*, 1887) refers the genus Rhacolepis, Agassiz, to the neighborhood of the Clupeidæ, and places it near Elops. It seems to have been one of the forerunners of the latter to have been developed in Jurassic times, and to have swarmed in Cretaceous seas. The fossils are common in the Serra de Araripe, in Northern Brazil.

Cretaceous.—Herr Carl Diener, in a contribution to the knowledge of the Cretaceous formation of Syria (Zeit. d. Deutschen geol., ges. 1887) gives a table of subdivisions, placing the Lebanon chalk partly in the Turonian and partly in the Cenomanian and the Arâja-Kalkstein at the bottom of the series.

M. S. Meunier, from experiments made upon the chalk of Beauval with acidulated water, arrives at the conclusion that the deposits of phosphate of lime found in chalk originated in the same way as the concretions of flint in the same material, *i.e.*, the two substances are sensibly soluble under like conditions, and their method of concretion is similar. It is a concentration by capillary action of a material which was originally distributed uniformly.

Tertiary.—Mr. A. S. Woodward revises the British Eocene

species of Myliobatis in the January issue of the *Ann. and Mag. Nat. History.* He distinguishes four—*M. dixoni, M. striatus, M. toliapicus,* and *M. labidens,* new species, the last from the Brackleshem Beds.

Mr. A. S. Woodward (*P. Z. S.,* 1887) asserts that a fossil representative of Chlamydoselachus, Garman, from the Pliocene beds of Oreiano in Tuscany, was described and figured (under another name) by Mr. R. Lawley in 1876. He suggests that this species be named *C. lawleyi.* The figures will be found in "Nuovi Studi sopra di Peci ed albri Vertebrati fossili delle cobline Toscane," di Roberto Lawley, Florence, 1876.

Dr. O. Roger describes (*Palæontographica,* vol. 32) some teeth of *Dinotherium bavaricum* H. v. Meyer, discovered in the valley of the Zusam, a small tributary to the Danube.

M. Lemoine has discovered in the eocene beds near Rheims, the teeth, jaws, etc., of five generic types of carnivora. The first of these equals Arctocyon in size, and seems analogous to Dissacus Cope. The two molars preceding the last show a commencement of the division of the anterior cusp of the tooth. Another type approaches Proviverra; another is named Tricuspiodon from the three cusps which in the molar teeth precede a very small heel, and recalls the Spalacotherium of the Prexbeek beds while another (Procynictis) has very singular molars, yet presents analogies with Amblotherium and Peramus of Owen. These forms tend to link the mesozoic with more recent faunas.

M. Gaudry has recently announced to the Acad. de Sciences of Paris the discovery of a gigantic tortoise in the middle Pliocene of Perpignan. The head, limbs, and part of the neck have been recovered from the encasing hard rock. In size this tortoise exceeds any living species, since the carapace is 1.20 metre long and a metre wide. The carapace of the Aldabra tortoise (*Testudo elephantina*) scarcely reaches a length of one metre. The only other tertiary or later fossil tortoises equalling in size the *Testudo perpiniana,* and that discovered twenty years since by M. Gaudry in the miocene of Mt. Lebanon, and a sub-fossil species (*T. grandidieri*) brought from Madagascar by M. Grandidier. *T. perpiniana* seems to have more affinity to *Testudo irrepta* and *triseriata* of Mauritius than to any others, since like them it has a depressed smooth carapace, relatively slender limbs, etc. In the great development of its sternum, however, it approaches the Atdabra tortoise.

Mr. A. Bell (*Geol. Mag.,* Jan., 1888) enumerates the few species of British Upper Tertiary corals known, and gives a description of *Sphenotrochus boytonensis* Tomes, n. sp.

The first part of Band. 32 of Zittel's *Palæontographica* contains "Contributions to the Knowledge of the Bryozoan-fauna of the Older Tertiary of Southern Bavaria," by Carl Koschinsky.

The Tertiary plants from the valley of the River Buchtama, at the foot of the Atlas, and described in *Palæontographica* (1886–87) by J. Schmalhausen.

PLISTOCENE.—Carl Ochsenius has contributed two papers upon the age of some parts of the South American Andes to the Zeitschrift der Deut. Geol. Ges. (1877). He attributes the elevation of the platform of Lake Titicaca to volcanic action, and assigns it to quaternary time.

MINERALOGY AND PETROGRAPHY.[1]

PETROGRAPHICAL NEWS.—In an article on the contact phenomena presented by certain Scottish olivine diabases, cutting sandstones and shales, Stecher[2] gives us some new and important ideas on the general subject of contact action. These olivine diabases are carefully described in all their varieties. Skeleton crystals of apatite, corroded augites, twinned plagioclase, dihexahedra of quartz, and various rare minerals are noted in them. The quartz shows anomalous action in polarized light, and is peculiar in that its hexagonal sections are seen under crossed nicols to consist of a kernel of quartz substance, surrounded by a rim of calcite. In some instances the olivine yields analcite by alteration. The most interesting portion of the paper is that which treats of the endogenous changes which have taken place in the dykes under the influence of the intruded rocks. Although more acid on their edges and in the neighborhood of sandstone inclusions, it was found that only in these places in the dykes is there any considerable development of olivine in perfect crystals. At a somewhat greater distance from the contact, the olivine becomes more skeleton-like in form. In the centre of the dykes it is absent. This is accounted for by Stecher in supposing that the material of the dykes cooled quickly on its edges, and thus preserved in their entirety the olivine which had already crystallized before the rock reached the surface of the earth. As the inner portion cooled more gradually, the magma became more acid as it dissolved material from the sandstone and slate pieces, torn from its walls, and thus re-dissolved the olivine, and then solidified under the changed conditions.—In contrast to the results obtained by Stecher, in which the effect of contact action is seen only in the eruptive rock, are those obtained by Greimi[3] in his studies of the phenomena presented by the intrusion of the Upper-Devon-

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Maine.
[2] Min. u. Petrog. Mitth. ix., 1887, p. 145.
[3] Neues Jahrb. f. Min., etc., 1881, i., p. 1.

ian schists by diabase, in the neighborhood of Weilburg an the Lahn, in Hessen, Nassau. In this case the diabase itself has suffered little alteration, but the schists show to a greater or less degree the effects of metamorphic action. The unaltered schists are composed of quartz, muscovite, hematite and other iron oxides, in which are lenticular areas and beds of calcite. Where altered they are seen to contain an isotropic groundmass in which are quartz, mica and a chloritic mineral. In addition to these the two newly formed minerals spinel and andalusite occur. In discussing his results, Greim concludes that the diabase supplied sodium and iron to the schists, which then underwent the alteration which is supposed by Rosenbusch to be characteristic of deep-seated metamorphism. —A third excellent paper on contact phenomena is that communicated by Rüdemann. This author has investigated the effect of the granite occurring at Reuth, near Gefrees, in the Fichtelgebirge, upon the clay slates, phyllites and amphibolites through which it cuts. He carefully describes the knotty-schists (Knoten-schiefer), the chiastolite and andalusite schists, and the hornfels resulting from this action, and reaches some general conclusions relative to the way in which an eruptive rock acts in the production of what are commonly known as contact rocks. In both phyllites and clay slates the first result of the metamorphic action is the concentration of certain of their constituents to form the spots (Knoten). In this stage there is little or no other change to be detected. The next stage is characterized by the formation of porphyritic crystals, chiastolite in the clay slates of Reuth and other localities, and biotite in the case of phyllites (Garbenschiefer). In the first case the andalusite owes its origin to the alteration of a light green chloritic mineral (grümbelite). In the case of the phyllites biotite replaces chlorite. In the third stage the end product of the alteration both of clay slates and phyllites is hornfels. This is a crystalline rock composed of quartz, biotite, muscovite and andalusite grains. Assuming that these changes in the sedimentary beds are directly connected with the presence of the large granite mass which they surround, the author supposes the earlier stages in the alteration to be due to the intense heating to which the rocks were subjected at the time of their intrusion by the granite. This is shown by the fact that in different beds different contact minerals have been produced, while the composition of the altered rocks corresponds to that of the corresponding unaltered beds from which they were derived. To account for the formation of hornfels, and the minerals so commonly found in it, Rüdemann supposes the energetic action of hot waters upon the constituents of the fragmental rocks. The paper is exceedingly well written, and contains very much of interest.—In connection with the discussion of

[1] Neues Jahrb. f. Min. etc., B. B. v., p. 643.

contact phenomena, a late paper by Hussak,[1] on the origin of the spots in altered sedimentary rocks (Knoten-and Frucht-schiefer) is worthy of close study. Rosenbusch regards these spots as due to the aggregation of the pigment, which was distributed evenly throughout the fragmental rocks before their intrusion by the eruptives. In certain cases he supposes these aggregations to pass by recrystallization into chiastolite and andalusite. Ward regards them as undeveloped andalusites. Other writers have described them as possessing characteristics which indicate their close connection with other mineral species. Hussak, upon examining the spotted schists from Tirpersdorf, Saxony and Hlinsko, Bohemia, found that the darker portions of the altered schists possess properties which can only be explained by supposing them to be the remains of altered cordierite, in the case of the Saxon rocks, and of altered chiastolites and andalusites in the rocks from Bohemia.

Mineralogical News.—Busz[2] has recently made quite an extensive study of *sphene* in order to determine whether the optical properties of different crystals are in any way dependent upon their chemical composition. Although quite a number of analyses of well crystallized specimens from various localities were made, no direct relation could be traced between their compositions and optical properties. The most instructive portion of the paper is that which treats of the crystallography of the subject. Crystals of nine different types are pictured on three lithographic plates. A number of new forms were detected, which added to those already known make a total of seventy-five thus far identified on the species.—Köchlin[3] has examined several of the oxides of manganese to decide as to the correctness of certain views held in regard to them. He finds as the result of etching that *manganite* is holohedral as Groth supposed. He believes *polianite* to exist as an independent mineral species distinct from manganite. It is orthorhombic, with an axial ratio: 1 : 10513; 1 : 0.63177. Finally, he regards *pyrolusite* as a mixture without a definite composition. "Its substance is not individualized; it has no proper crystal form." It occurs almost exclusively as a decomposition product of other manganese minerals.—Although *pseudobrookite* was first described by Koch[4] some ten years ago, our knowledge of its optical properties is very limited. A new discovery of little crystals of the mineral in a nephelinite from Katzenbuckel has given Lattermann[5] the opportunity to determine its optical constants. The tiny crystals are bounded by the planes $\infty \bar{P}\bar{\infty}$, $\infty \breve{P}\breve{\infty}$, ∞P and $\frac{1}{3} \bar{P}\bar{\infty}$. Their color is orange brown. They are weakly pleochroic. The plane

[1] Min. u. Petrog. Notizen, Bonn.
[2] Neues Jahrb. f. Min., etc.. Beil. Bd. v., p. 330.
[3] Min. u. Petrog. Mitth. ix., 1887, p. 22.
[4] Min. u. Petrog. Mitth. ,1878, i., p. 344.
[5] Min. u. Petrog. Mitth. ix., 1887, p. 47.

of their optical axes is the basal pinacoid, and the axial angle, measured in oil, is 85° 30′. *A* is the acute bisectrix. The mineral is insoluble in hydrochloric acid. It dissolves slowly in boiling sulphuric acid, but rapidly in a mixture of sulphuric and hydrochloric acids. An analyses of separated material yielded: $Tio_2 = 46.79\%$; $Fe_2O_3 = 48.64\%$ $Mgo = 4.53\%$. Very beautiful rich red, transparent crystals of *rhodochrosite* are described by G. F. Kunz[1] from the John Reed mine in Alicante, Lake co., Colorado. Some of the crystals from this locality "are as pellucid as red Iceland span and show the same double refraction." The same author[2] describes some curious groups of quartz crystals from the vicinity of the town of Pinal, Pinal CO., Arizona. Six or more little crystals of the usual form are so arranged as to form a hollow cylinder, with the general outline of a large quartz crystal. He also mentions a white opaque variety of hydrophane from Colorado, which is remarkable in that it can absorb more than its own volume of water. When wet it is perfectly transparent.—Mr. R. B. Riggs[3] of the United States Geological Survey has published the results of the analyses of a suite of tourmaline crystals from various localities. The conclusions reached by Mr. Riggs, after an immense amount of very careful work, are of very great interest as establishing with a good deal of accuracy the composition of this complicated group of minerals. The figures obtained lead the author to regard tourmaline as a simple boro-silicate with the general formula $R_9\ Bo_2\ (S\ i\ O_4)_2$, which for the three types recognized by him became:

I. Lithia tourmaline = $12\ SiO_2.\ 3B_2O_3.\ 4H_2O.\ 8Ae_2O_3.\ 2(NaLi)_2O$.

II. Iron tourmaline = $12\ SiO_2.\ 3\ B_2O_3.\ 4H_2o.\ 7AE_2O_3.\ 4\ Fe.O.\ Na_2O$.

III. Magnesia tourmaline = $12\ SiO_2.\ 3B_2O_3.\ 4H_2O.\ 5AE_2O_3.\ 2\tfrac{8}{3}\ MgO.\ \tfrac{2}{3}\ Na_2O$.

It is interesting to note that while the color of the iron and magnesian varieties depends upon the *amount* of iron in their compositions, in the case of the lithium varities, containing manganese and iron, it depends upon the *ratio* between the manganese and iron constituent, being colorless, pink or pale green when the amounts of these are equal, red when manganese is in excess, and green or blue when iron is in larger quantity.

[1] Amer. Jour. Sci., Dec. 1887, p. 477.
[2] Ib., p. 479.
[3] Ib., Jan., 1888, p. 35.

BOTANY.[1]

Planchon's Revision of the Ampelideæ.—In the recently received Part 2 of the fifth volume of De Candolle's Monographiæ Phanerogamarum, J. E. Planchon makes a thorough revision of the Ampelideæ. Such considerable changes are introduced in the synonymy that it may be well to present a summary of the work here.

The order is restricted somewhat from the limits assigned it by Bentham and Hooker in the *Genera Plantarum*, by the exclusion of Leea with its twenty species or so. The remaining species (386) are distributed among ten genera, instead of two, as in the *Genera Plantarum*. It will be remembered that in the latter work the authors reduced almost everything to one genus—Vitis. Planchon, on the contrary, divides the old genera and constructs several new ones. The following abridged conspectus of the genera will serve to show their principal characters, and the method pursued in differentiating them:—

Flowers polygamo-diœcious; petals 5, cohering; style (short) conical; hypogynous glands 5; berries two-celled, 2–4 seeded; climbing shrubs with simple, variously lobed leaves.........I. *Vitis.*

Flowers polygamo-monœcious; petals 5 (rarely 4), spreading; style short-conical; disk annuliform, erect; berries two-celled, 2–4 seeded; climbing shrubs with simple or palmate or palmately compound leaves...II. *Ampelocissus.*

Flowers polygamo-monœcious; petals 4–5, spreading; style short; disk annuliform; berries two-celled, 2–4 seeded; shrubs with undivided or palmatisect leaves.... ....III. *Pterisanthes.*

Flowers polygamo-monœcious; petals 5, free, spreading; style long, subulate; disk cup-like; berries two-celled, 2–4 seeded; shrubs, with 5–3 foliate leaves.......................IV. *Clematicissus.*

Flowers polygamo-diœcious; petals 4, expanding; style short; stigma 4 lobed; disk hypogynous; berries 2–4 seeded; shrubs with pedate leaves..V. *Tetrastigma.*

Flowers polygamo-monœcious; petals 5, expanding; style short; disk 5 lobed, adnate to ovary; berries 2 celled, 3–4 seeded; shrubs with 3-foliate leaves......................................VI. *Landukia.*

Flowers hermaphrodite; petals 5, spreading; style subulate, thick; disk obsolete; berries 1–2 seeded; climbing shrubs with digitate or palmatilobed leaves...................VII. *Parthenocissus.*

Flowers hermaphrodite; petals 5 (rarely 4), spreading; style subulate; disk cup-like, 5 (rarely 4) lobed; berries 1–2 celled, 1–4 seeded; climbing shrubs with leaves from simple to pinnately compound............ ....VIII. *Ampelopsis.*

[1] Edited by Prof. Chas. E. Bessey, Lincoln, Neb.

Flowers hermaphrodite or pseudo-hermaphrodite; petals 5–7, thick, spreading; disk annular; berries 1–2–3–4 seeded; climbing shrubs with trifoliate, unifoliate, undivided or palmatilobed leaves. ....IX. *Rhoicissus.*

Flowers hermaphrodite; petals 4, spreading or sometimes cohering; style subulate, slender; disk cup-like; berries 1–2–3–4 seeded; creeping, erect or climbing shrubs with undivided, lobed or compound leaves..X. *Cissus.*

The species of Vitis are arranged in two sections, viz., I. Euvitis and II. Muscadinia, the former containing seven series. The disposition of our North American species under this arrangement is as follows—

Section I. Euvitis.

Series 1. Labruscæ.

V. labrusca L. Fox Grape. Atlantic States.

Series 2. Labruscoideæ.

V. candicans Engelm. Mustang Grape. Texas.

V. caribœa D. C. South Florida.

Series 3. Æstivales.

V. æstivalis Michx. Summer Grape. Atlantic States and Mississippi Valley.

V. lincecumii Buckl. (= *V. æstivalis* Michx., var. lincecumii Engelm). Post Oak Grape. Texas.

Series 4. Leucobryæ.

V. californica Benth. California.

V. arizonica Engelm. Arizona.

Series 5. Cinerascentes.

V. berlandieri Planch. (= *V. monticola* Durand in Bull. Soc. d'Acclim., ix., p. 434,— *V. monticola* Engelm. in Bush. Cat.— *V. æstivalis* A. Gray in Plantæ Lindheimerianæ). Texas and New Mexico.

V. cinerea Engelm. (= *Vitis æstivalis* Michx. var.? *cinerea* Engelm. in Gray's Manual, p. 679). Mississippi Valley from Illinois southward.

V. coriacea Shuttl. (= *V. caribœa*? in Chapman's Flora of the Southern States.— *V. candicans* in Watson's Bibliographical Index to N. A. Botany). South Florida to Louisiana.

Series 6. Rupestres.

V. rupestris Scheele. Sugar Grape. Tennessee, Missouri and southwestward.

Series 7. Cordifolio-Ripariæ.

V. cordifolia Michx. Frost Grape. New York to Nebraska, and southward to the Gulf of Mexico.

V. riparia Michx. Riverside Grape. Labrador to Florida, and West to the Rocky Mountains. This species includes the form *palmata* of Engelm.

V. rubra Michx. Tennessee to Missouri and southward. Related to, and generally confused with, the preceding species.

Section II. MUSCADINIA.

V. rotundifolia Michx. (= *V. vulpina* L. in Gray's Manual, p. 113). Muscadine Grape. Maryland and Kentucky to Arkansas and southward.

Two other species are described, but for want of full material their places in the adopted scheme are not assigned. They are:—

V. araneosa Leconte, from northern Georgia and Illinois.

V. monticola Buckley, from Texas. This is regarded by Watson (Bibl. Index N. A. Bot., p. 171) as a variety of *V. æstivalis* Michx.

The genus Parthenocissus includes seven species, one of which is *P. quinquefolia* Planch., the well-known "Virginia Creeper," of the United States, hitherto known as *Ampelopsis quinquefolia* Michx. In this genus is found, also, the Japan Creeper (*Ampelopsis veitchii* of the gardeners), hereafter to bear the name of *P. tricuspidata* Planch.

Ampelopsis, as now restricted, contains two North American species, viz., *A. cordata* Michx. (= *Vitis indivisa* Willd. of Gray's Manual, p. 113), and *A. bipinnata* Michx. (= *Vitis bipinnata* Torr. and Gr. of Gray's Manual l. c. and *V. arborea* L. of Watson's Bibl. Index N. A. Bot., p. 171).

Cissus now includes 214 species, of which but three are found within the United States, viz., *C. sicyoides* L., with many subvarieties or forms, of which *floridana* occurs in southern Florida; *C. acida* L., southern Florida; *C. incisa* Desm., Florida to Texas.—*Charles E. Bessey.*

POSTAL REGULATIONS AS TO BOTANICAL SPECIMENS.—In a communication dated Feb. 11th, 1888, to Dr. Charles R. Barnes, of the University of Wisconsin, the Third Assistant Postmaster-General makes the following ruling, viz.:—

"Under the recent Act of Congress in relation to permissible printing and writing upon second, third and fourth class matter, there may be placed upon specimens of dried plants, or on any other

natural history specimens, to be transmitted by mail, without subjecting them to other than fourth-class rate of postage, labels bearing the written name of the specimens, locality and date of collection, and the collector's name—where these inscriptions are wholly for purpose of identification or description."

Ordinary botanical labels which had been submitted by Dr. Barnes were accepted as permissible.

THE GERMINATION OF DODDER.—In some recent investigations on germinating Dodder (*Cuscuta gronovii*) we have observed an interesting fact in regard to the manner of separating itself from the soil which we have not found mentioned elsewhere. When the plant has reached something adapted to its needs as a parasite—*Forsythia viridissima* in our observations—it winds about it loosely at first, then after the manner of a tendril quickly contracts, bringing its coils close to the host, that the haustoria may penetrate the bark. This contraction pulls up the root, leaving it loosely hanging by the host, sometimes half an inch above the soil, where it withers and dries.—*Henrietta E. Haaker*, *Botanical Lab.*, *Mt. Holyoke Sem.*, *Feb.* 17, 1888.

THE FOSSIL FORESTS OF THE YELLOWSTONE NATIONAL PARK.—At the February meeting of the Washington Biological Society, Professor Knowlton gave an account of a visit to these fossil forests, which are located mostly in the northeastern portion of the park, a locality rarely visited by tourists. The largest isolated trunk seen was twenty-six feet in circumference, without the bark, and twelve feet in height. In the edge of a cliff trunks are exposed to a height of thirty feet. Specimens from about 300 of these trees are now being identified. They represent about twenty species, including the genera Pinus, Sequoia, and Taxus.

NEW SPECIES OF UREDINEÆ.—At the February meeting of the Washington Biological Society a paper was read by B. T. Galloway describing seven new western Uredineæ collected by Tracy and Evans in 1887, and named by Tracy and Galloway. They were *Uromyces arizonica*, *Puccinia fragilis*, *Puccinia caulicola*, *Puccinia vertisepta*, *Æcidium draba*, *Æcidium heliotropii*, and *Æcidium ellisii*. It is to be hoped that the authors will also publish their descriptions in the *Journal of Mycology*, in which, in our opinion, all descriptions of our fungi ought to appear.

BOTANICAL NEWS.—The announcement is made that Dr. Lorenzo G. Yates, of Santa Barbara, California, with the assistance of J. G. Baker, of Kew (England), will soon bring out a book entitled "All Known Ferns," which will consist of an alphabetical list

(generic and specific) of all the ferns of the world. It is not to include descriptions, but references are to be given in every instance to descriptions. Synonyms will be given, and the distribution of every species will be indicated. It promises to be a very useful book.——Miss Jane H. Newell, of Cambridge, Mass., has begun the publication, in parts, of a little work to be called "Outlines of Lessons in Botany," designed to be of use to teachers who wish to do more than follow the old methods of botanical teaching. The lessons outlined "are suitable for children of twelve years of age and upwards." Directions are given for raising seedlings, and for making observations upon them in their growth. The parts before us are privately printed, in order to have them tested by other teachers before publication. They may be obtained by any teacher who will use them experimentally, by addressing the author at 175 Brattle street, Cambridge.——DeBary's Lectures upon Bacteria, English translation, has been received from Macmillan & Co. It is a small work, of a sufficiently popular style to enable any well-educated man to get a good idea of the subject. A fuller notice will appear later.——Detmer's Pflanzenphysiologische Praktikum, from Gustav Fischer, of Jena, promises to be a most valuable book in the botanical laboratory. It is an octavo of 352 pages, and is illustrated with 131 wood-cuts.——Dawson's "Geological History of Plants" is an interesting volume of the International Scientific Series, which has just appeared. The style is popular, but the treatment is thoroughly scientific.

ZOOLOGY.

Conjugation of the Infusoria.—The following abstract of M. E. Maupas's observations on the conjugation of the Infusoria (*Comtes Rendus*, 1887, p. 356–9) is taken from the *Journal of the Royal Microscopical Society*. The micronucleus is a hermaphrodite sexual element, of sole importance in conjugation. In the stage (A) it increases in size; it then divides twice (B and C), and eliminates the corpuscles de rebut. This effected, it divides again (D), differentiating a male and female pronucleus. In the next stage (E) the male elements of the two conjugating Protozoa are exchanged, and the new male nucleus fuses with the original female portion. In the next two stages (F and G) the nuclear dualism characteristic of the Ciliata is re-established (the old macronucleus having broken up and been eliminated meanwhile). In the last stage (H) the ex-conjugates reassume their original organization before dividing for the first time.

What is the meaning of all this? There is no special sexual reproduction or generation. There is no acceleration of division after conjugation. It is a period of risk, especially during the

inertia of reconstruction. An *Oxydromus grandis* had from 40,000 to 50,000 descendants while a pair were indulging in a single conjugation. It is a source of destruction, not of the multiplication of individuals.

The riddle was solved by a long series of careful observations. In November, 1885, M. Maupas isolated a *Stylonychia pustulata*, and observed its generations until March, 1886. By that time there had been 215 fissiparous generations. But at that time the colony gave in; the individuals had lost the powers of nutrition and reproduction. Individuals removed at various stages, however, had conjugated with individuals of a different origin. The same experiment was repeated with other forms. In March, 1886, an ex-conjugate from one of the couplings referred to was removed and watched until July 10, when the family again gave in. During that time 315 divisions had been observed. Numerous conjugations had been effected with members removed to other families. This was done till the 130th generation, and till then all the conjugations were fertile. About the 180th generation individuals of the same family which had not hitherto been in contact with one another began in despair to conjugate. The results, however, were *nil;* the conjugates did not even recover from their forlorn hope. Other cases are related.

The result is evident. The process is essential for the *species.* The life runs in developmental cycles of multiplication by division, which are strictly limited. If conjugations with unrelated forms do not then occur the life ebbs. The sexual conjugation of the Ciliates is thus a rejuvinescence, as Bütschle and Engelmann maintained. It is essential as a reorganization of the nucleus. After a prolonged series of divisions the nucleus undergoes senile degeneration. Without conjugation death would be inevitable. The death is a natural one, which some would deny. Sexual conjugation is the necessary condition of their "eternal youth and immortality."

Germinal Layers of Loligo.—Mr. S. Watase has been studying the development of *Loligo pealei.* He finds that, owing to the immense amount of food yolk present, the gastrulation is masked, and that the mesoderm is formed before the endoderm is fully outlined. He traces the origin of the ink-bag and rectum from the proctodeal invagination, while the stomodeal inpushing gives rise to radula sac, salivary glands, and the digestive glands or "liver." The endoderm is concerned only in forming a yolk membrane, and Mr. Watase thinks it wholly disappears, taking no part in the structure of the adult organs, the alimentary tract being formed solely of stomodeal and proctodeal invaginations.

The Sponge Shrimp, Alpheus.—Mr. F. H. Herrick contributes three articles on Alpheus to No. 63 of the John Hopkins

University Circulars. He has studied five of the eight known West Indian forms, and finds that they vary considerably in habits and life history. *Alpheus minus* has a complete metamorphosis; in *A. heterochelis* the metamorphosis is abbreviated, while in a species provisionally called *A. præcox* it is almost lost, the young having the big claws developed when it escapes from the egg. In twenty-four hours after hatching the young of the last-mentioned species molt twice, and then have, except size and color, all the characteristics of the adult, even to the pugnacious habits. Although but a tenth of an inch in length, they snap the fingers quite audibly. Mr. Herrick attributes this abbreviation of the development to the parasitic habits, this species, like some others, living in sponges, but burrowing more deeply in them than do the others.

In the embryonic development Mr. Herrick notes that the segmentation proceeds until a syncitium of eight nuclei is formed, and then arise yolk pyramids. After the nuclei reach the surface a germinal area is outlined, and then nuclei migrate from all parts of the surface into the yolk. The gastrulation, which is small, occurs later, and its products likewise pass into the yolk, most of them wandering to the dorsal surface. These wandering cells are believed by endogenous growth to give rise to the "secondary mesoderm cells." Some of these are regarded as forming the regular mesoderm, while others give rise to the blood corpuscles. A remarkable plasticity of the early germinal layers is noticed, it being almost impossible to separate the products of invagination into layers, or to separate others which wander from the ectoderm to which they apply themselves.

Phosphorescent Organs of Fishes.—On the head and sides of certain deep-sea fishes occur small shining bodies, which Leuckart, Ussow, and Emery have regarded as accessory eyes, but which are now considered as phosphorescent organs. Dr. R. von Lendenfeld has recently studied these organs as exhibited in the collections of the "Challenger" Expedition, and comes to some interesting conclusions. He recognizes no less than twelve types, more than one of which may occur on a single fish. Most of these are small rounded bodies scattered or regularly-arranged upon the upper surface of the body; these are called the "regular ocellar phosphorescent organs," and may be either simple or compound. The simple forms are always isolated, and may be divided into two types according as they are provided with (*Opostomias micripnus, Echiostoma barbatum, Pachystomias microdon, Malacosteus indicus, Astronesthes niger*) or lack a pigmented mantle (*Opostomias micripnus*). In no case are they provided with a reflector. The compound organs, which always have a pigmented mantle, consis of a proximal sack-like body and a distal goblet-shaped half, the two portions being separated by a constriction. Some of these (*Oposto-*

mias micripnus, Echiostoma barbatum, Pachystomias microdon, Astronesthes niger) are isolated and stand upright upon the surface, but are still more distinguished by the lack of a reflector. In others (*Argyropelecus hemigymnus, Sternoptyx diaphana, Scopelus benoiti*) the organ is provided with a shining reflector composed of needle-shaped or filiform elements. All of the foregoing are sunk in the skin, but in *Xenodermichthys nodulosus* occur simple organs which are provided with a pigmented mantle, and which project beyond the general surface and in some cases become stalked. In *Halosaurus macrocheir* and *H. rostratus* the organs are situated upon the scales of the lateral line and have a spindle shape.

The other main group of organs embrace irregular glands which may be scattered (*Astronesthes niger*), or be found on the under jaw (*Argyropelecus hemigymnus, Sternoptyx diaphana*); beneath the operculum (*Halosaurus macrocheir*); on the barbels and fin-rays (*Opostomias micripnus, Malacosteus indicus*); or may have a suborbital position, in the latter instance either having (*Echiostoma barbatum, Pachystomias microdon, Malacosteus indicus, Scopelus benoiti*) or lacking a reflector (*Opostomias micripnus, Astronesthes niger*).

The histology of these various types is described. All of the ocellar organs have a large blood and nerve supply, as do the suborbital organs of the other division. The others are tubular glands. Usually the ocellar organs are innervated from branches of the spinal nerves, but in *Echiostoma barbatum* the suborbital organs receive their nerve supply from a branch of the trigeminus, which suggests a comparison with the electric nerve of the torpedo.

Both Guppy and Willemoes Suhm have witnessed the phosphorescence in Scopelus, and the similarity in structure of all these organs renders it probable that all are phosphorescent. Regarding the glandular organs the evidence is less direct, but judging from the analogy of other forms von Lendenfeld regards them as secreting a phosphorescent mucus. In both we have to deal with various modifications of the mucous canal system. Dr. von Lendenfeld states that the parietal organ of Sphenodon (Hatteria) has no homology with these organs, and that it is not, as has been suggested, a phosphorescent organ.

EUTHERIA AND PROTOTHERIA.—In the AMERICAN NATURALIST for December, 1887 (vol. xxi., p. 1103), in a notice of "Thomas on Mammalian Dentition," it is "observed that the unnecessary terms Prototheria and Eutheria, which are generally ascribed to Professor Huxley in England, were really introduced by Professor Gill."

Two quite different propositions were involved by the use of the terms used by Professor Huxley and myself. Professor Huxley

simply substituted my names Prototheria for the Ornithodelphia or Monotremes, and Eutheria for the Monodelphia or Placentalia, introducing a new term—Metatheria—for the Didelphia or Marsupialia. I perfectly concur with the belief that in these senses the terms are unnecessary. But far different was my use of the terms in question, and they were the expressions of a higher generalization. Almost universally the placental mammals had been contrasted with the non-placental. In my "Arrangement of the Families of Mammals" (1872), however, I combined (pp. 45, 46) the Placentals and Marsupials in one category (I.) with the Monotremes, in another (II.) fortifying the contrast by numerous anatomical characters; for these two sections I proposed the names EUTHERIA (I.) and PROTOTHERIA (II.) in the table of "Contents" (pp. v., vi.) of the Arrangement. Subsequently, in "Johnson's New Universal Cyclopædia" (vol. iii., 1877, p. 262), in the long article "Mammals," I adopted the terms in connection with the definitions. It was then prevised that "the chief modifications of the class of Mammals are expressed in three types which have been differentiated as sub-classes, viz., Monodelphia, Didelphia, and Ornithodelphia; these are themselves opposable under two categories, EUTHERIA and PROTOTHERIA." Immediately following, the groups so named were defined at length.

In the sense in which the terms Eutheria and Prototheria were used by myself I consider them to be necessary as the verbal expressions of the generalizations formulated, but as used by Professor Huxley the names are simple synonyms of others long before in general use, and consequently "unnecessary."—*Theodore Gill.*

THE MULTITUBERCULATA MONOTREMES.—It is announced in *Nature* (Feb. 16, 1888, p. 383) that Mr. E. B. Poulton has discovered teeth in sections of the jaws of a young *Ornithorhynchus anatinus*, made by Professor W. N. Parker. Three have been found in the upper jaw and two in the lower (the ramus imperfect), in the regions covered by the corneous bodies of the adult. The anterior tooth of the maxilla is "long, narrow and simple, as compared with the others." The other teeth "were broad and large, those of the upper jaw containing two chief cusps in the inner side of the crown, and three or four small cusps on the outer side, while this arrangement was reversed in the lower jaw."

This observation is of the highest importance. The description reads like that of the dentition of the Plagiaulacid genus Ptilodus. *It renders it extremely probable that the Multituberculata are Monotremata,* and not Marsupialia, as has been supposed.—*E. D. Cope.*

ZOOLOGICAL NOTES.—PROTOZOA.—Dr. D. S. Kellicott describes and figures five new species of American Infusoria in the *Microscope* (vii. p. 226). They are *Podophrya inclinata, P. flexilis, Carchesium granulatum,* and *Opercularia humilis.*

Professor Ernst Haeckel has published an abridgement of his recent monograph of the "Challenger" Radiolaria. It appears under the title "Grundriss einer allgemeine Naturgeschichte der Radiolarian," in a quarto volume of 266 pages, illustrated with 64 of the plates of the "Challenger" Report. The price is sixty marks.

ECHINODERMS.—The brothers Sarasin call attention (*Zool. Anz.*, x. 674) to the powers possessed by *Linckia multifora* of repairing injuries, and figure a specimen where an arm has budded at its extremity a new star fish with four new rays, but state that the madreporic body is not yet developed.

WORMS.—Beddard calls attention (*Zool. Anz.*, No. 268) to the so-called prostrate glands of earth-worms, claiming that these organs in Perichæta an the homologue of the atrium in other earth-worms. He also describes the reproductive organs of Monilogaster, which differ from those of other worms and resemble those of the limicolous forms. He shows that Claparède's division of the Oligochætes is unnatural.

MAMMALS.—August Fjelstrup describes (*Zool. Anz.*, No. 269) the histology of the skin of the black fish, *Globiocephalus melas*, and incidentally states that Eschricht's statement that the number of hairs about the lower jaw and nasal openings and their arrangement may be used in identifying fœtal Cetacea is erroneous, these varying with size and development.

ENTOMOLOGY.[1]

THE GRASS-EATING THRIPS.—Attention is called by Dr. Lintner in his annual report (reviewed below) to "An Unknown Grass-Pest." As the insect in question is one which I have had under observation for many years, I am able to give more definite information regarding it than is contained in Dr. Lintner's report. In fact, I feel a peculiar personal interest in the insect in question, as it was the first species upon which I made original observations; and in a little work[2] published thirteen years ago I gave a brief account of it.

This grass-pest is exceedingly common and widespread. It is a species of Thrips, which infests the stalk just above the upper

[1] This department is edited by Professor J. H. Comstock, Cornell University, Ithaca, N. Y., to whom communications, books for notice, etc., should be sent.

[2] Notes on Entomology: A Syllabus of a Course of Lectures Delivered at the Cornell University. Ithaca, 1875. (In the second edition of this work the account cited was omitted.)

joint. The young insect pierces the stem in this place, where it is tender, and, sucking the juice from it, causes it to shrink and all parts above the injury to die. It appears first each season upon June grass, and frequently, a short time after this grass has headed out, the fields will be yellow with the dead heads of the grass. Later, the insect spreads to timothy and the other grasses; but it never becomes as common upon these as upon *Poa pratensis.* The species obtains its growth within the sheath of the upper blade, at the point indicated above. After it has acquired wings it crawls forth from this secure retreat, and can be swept from the grass in great numbers. As yet I have been unable to complete the life-history of the species by determining the manner in which it passes the winter and the mode of oviposition. Neither have I been able to suggest any practicable method of preventing the increase of the species. At one time I thought that the early mowing of the infested grass, causing the infested stalks to dry and become unfit food for the young Thrips, would accomplish this purpose, but, later, I found the insects in question feeding upon leaves of grass.

In the work referred to above the species was designated as *Limothrips poaphagus* MSS., but reference was made only to the habits of the insect. A description of the species has not yet been published.—*J. H. Comstock.*

Probable Increase in Entomological Investigations.—Although the United States has taken a very prominent position as regards investigations in economic entomology, the work which the Department of Agriculture at Washington and the few State Entomologists have been able to do has not at all been commensurate with the demands of the subject. The life-history of a very large proportion of the insects that are of economic importance remains unknown. And we are unable, as yet, in many cases where the transformations of the insect are known to suggest any practicable means of preventing its ravages. The field for investigation has been altogether too large to be at all thoroughly worked by the small number of workers employed. There is now, however, a prospect of a change. The establishment by Congress of an agricultural experiment station in each of the States in connection with the agricultural colleges will result in a considerable addition to the number of investigators in economic entomology. No one of the sciences has a more immediate application to agriculture than entomology, and doubtless entomological experiments will form a prominent part of the work of the newly-established stations.—*J. H. Comstock.*

The Report of the State Entomologist of New York.—Dr. Lintner's report for the year 1886 has just appeared. It forms an interesting volume of about seventy-five pages. It is, however,

briefer than would have been the case but for its having been unexpectedly called for at an unusually early date, as explained in the letter of submittal.

The more important entomological events of the year noted by Dr. Lintner are the following: Owing to the ravages of the hop-aphis (*Phorodon humuli*), the hop-crop throughout the State of New York the present year has proven almost an entire failure. It is estimated that only about eight per cent. has been secured—twelve thousand bales in lieu of one hundred and fifty thousand. It is also estimated that one-third of the onion crop was destroyed by the onion-fly, *Phorbia ceparum.*

"A new attack on wheat by a saw-fly larva" is described. The larva in question crawls up the stalk, cuts it off about one inch below the head, and eats the soft green straw. One correspondent states that early in June the ground was thickly scattered with cut-off heads. An injury to strawberry plants, supposed to be caused by *Bembidium quadrimaculatum,* is discussed, but definite conclusions have not been reached. Serious injury to potato-leaves and to the foliage of carrots and parsnips by plant-lice in Massachusetts is noticed.

There are many other short articles on well-known insects. The report is concluded by a list of publications and articles published by the entomologist in various journals during the year, together with an abstract of each. The list includes nearly fifty titles, and is evidence of great industry on the part of Dr. Lintner.

SAY'S ENTOMOLOGY.—Mr. Howard, in a paper before the Entomological Society of Washington, calls attention to a very general misconception regarding the Leconte Edition of Say's works. This edition does not include all of the entomological writings of that author, and it is evident that the editor simply intended to bring together the descriptive papers of Say.

GIANT LEPIDOPTEROUS LARVÆ IN AUSTRALIA.—"The larvæ of *Chalepteryx collesi,* a large moth which has been unusually abundant during the past summer in the vicinity of Sydney, often attains the length of seven inches and is robust in proportion. The larvæ of the beautiful swift, *Zelotypia stacyi,* measures eight inches when fully grown, and I have seen several *Cossus* larvæ of similar dimensions."—*A. Sidney Olliff, Australian Museum, Sydney, N. S. Wales, in "The Entomologist," Vol. XXI., p. 19.*

INSECTS AS FOOD FOR MAN.—"In Australia the hairless larvæ of such insects as *Zelotypia, Hepialus, Charagia, Pielus,* and many wood-boring Coleoptera—particularly Longicorns and Rynchophora—are eaten raw or cooked by the aborigines and by not a few depraved members of the white community.—*A. Sidney Olliff, l. c.*

THE CHINCH-BUG IN IOWA.—A bulletin of the Iowa Agricultural College, by Professor Osborn, entitled *The Chinch-Bug in Iowa*, has just been issued. It includes a summary of the habits of the species and a discussion of some experiments in controlling this pest.

EMBRYOLOGY.

THE "VENTRAL SUCKERS" OR "SUCKING DISKS" OF THE TADPOLES OF DIFFERENT GENERA OF FROGS AND TOADS.[1]—Thiele in this very interesting paper, shows that the singular sucker-like organs found behind the mouth and under side of the head in the tadpoles or larvæ of frogs and toads differ widely in form in different genera. They are clearly for the purpose of enabling the young larvæ to attach themselves to various fixed bodies in the water, such as weeds, the gelatinous egg-strings and masses from which they have been hatched, etc. They are thus afforded support and prevented from sinking into the ooze to smother, and their enemies thus also doubtless find them a less ready prey. These disks are also shown by Thiele not to be of the nature of suctorial organs, but are glandular, being formed wholly of thickened epidermis which is elevated, its cells becoming lengthened or columnar. There is no muscular suctorial apparatus developed in connection with them, and they are secretory, secreting a sticky mucus or slime which serves to fasten the young tadpole to its resting place. That an actual secretion is formed is proved by the fact that a slimy thread of secreted matter is drawn out from the disk if the young tadpole be forcibly withdrawn from its support. They are specifically larval organs, and persist only for one to two weeks after hatching. They may be compared to the "balancers" found behind the mouth in the larva of *Amblystoma*. In *Triton* stalked suckers are said to be present, which Balfour compares to the sessile "suckers" of larval toads and frogs. But the present writer cannot see how it is possible to homologize the sucking disk of larval gar pikes with the adhesive organs in larval Batrachians, because in the former the disk is in front of the mouth and in the latter it is usually quite behind the mouth, only in one case (Hyla) are the suckers found near the angle of the mouth. The larva of *Xenopus* has two long barbels at the side of the head from the sides of the upper lip. But in this last case even, it is doubtful if there is any homology with the "suckers" of other larval *Anura*. There certainly cannot be any homology between the organ of the gar-pike's larva and that of young toads and frogs, though it is probable that these organs in the latter are truly

[1] Der Haftapparat der Batrachierlarven, von Johannes Thiele. Zeitsch. f. wiss. zool. xliv. pp., 67–79, pl. x. 1887.

homologous with the "balancers" of the larvæ of salamanders of the type of *Amblystoma* and *Triton.*

Thiele further shows that inasmuch as these structures are glandular with no muscular apparatus, that the terms "sucker" or "sucking disk" are misnomers as applied to these organs. A better term might be proposed for these structures in young tadpoles, and the writer would suggest that they be called *epidermal adhesive organs.*

The form of these organs differ widely in different genera of *Salientia* and will afford a valuable means of identifying the larvæ. In *Discoglossus pictus,* the adhesive organ behind the mouth is hemispherical, with a V-shaped groove on its surface, the V opening forward. In *Pelobates fuscus* the adhesive organ is Y-shaped with a Y-shaped groove on its surface and the limbs of the whole organ extending forward to embrace the angles of the mouth. In *Bufo vulgaris* the organ is V-shaped, with a V-shaped groove, and the limbs of the V come into contact with the angles of the mouth. In *Bufo viridis* the organ is cresent-shaped, not in contact with the mouth, but a little behind it, as in *Discoglossus,* and with a widely open V-shaped groove. In *Rana esculenta* and *R. fusca* there are two distinct oval adhesive organs on either side of the median line with traces of a V-shaped groove connecting them, and both are behind the mouth. In *Rana agilis* there are two separate adhesive organs, one on each side behind the mouth, and each has a slight depression on its posterior border. In *Hyla arborea* there are two circular adhesive organs close to the angles of the mouth at either side. In *Bombinator igneus* there are two oval adhesive organs behind the mouth, which are in close contact, and later on fuse into a single organ, both having an oval depression in the centre.—*J. A. R.*

PSYCHOLOGY.

THE COPE-MONTGOMERY DISCUSSION.—*The Theism of Evolution.*—The following is offered as a synopsis of the leading opinions maintained by the writer in a series of articles furnished by him to *The Open Court* during 1887, in reply to articles written by Dr. Edmund Montgomery:—

I. PRINCIPIA.

1. In the universe there exist both mind and matter, subject and object.

2. The evidence for the existence of mind is found in consciousness; first, of ourselves, and, second, of other living beings, whose motions, identical with those which we make under the influence of our own consciousness, convince us of their possession of it.

3. The evidence for the existence of matter is found in certain modifications experienced by our consciousness, especially in the sensations of extension and resistance.

4. Since consciousness does not exist apart from the motion of matter, we regard it as a property of the matter in motion, that is, as a property of energy.

II. FACTA.

1. The gross activity of consciousness is immediately conditioned by matter.

2. In certain of its thought-forms consciousness is not immediately conditioned by matter, but only by its past experience of matter.

3. The forms of consciousness mentioned under (2) control the direction of energy, and hence the use of matter.

4. The proof of (3) is seen in the designed movements of animals in which they direct a current of energy in order to produce a result more or less exactly adapted to satisfy the conditions demanded by a sensation.

5. As soon as a designed movement has been fully acquired, that is, so soon as the animal mechanism necessary for its production has been created, it is performed without consciousness of effort, and may be performed unconsciously, or even in a state of general unconsciousness. Therefore designed automatic acts originated in consciousness.

6. Evolution of organic types is the resultant of the interaction of subject and object, or the living organism and its environment.

7. The function of the organism *in evolution* is to produce variations in its structure as an effect of its motions.

8. The function of the environment in evolution is to impress or destroy the organism, or to restrain, permit or encourage its use; that is, to exercise natural selection.

9. The effect of this interaction, where the movements of the organism are stimulated, is to produce specialized structures and types out of generalized ones. Where the action of the organism is not stimulated, the result is to produce degenerate types.

10. It follows that organic evolution is the result, mediate or immediate, of consciousness; that is, of the interaction of conscious energy or its residua, the organic vital energies, in interaction with the environment.

11. Organic energies perform chemical syntheses and analyses, demonstrating the control of vital over chemical energy.

12. Whereas physical and chemical energies result only in dissipation of energy and integration of matter, the energy of evolution produces complication of matter for the profitable direction and storage of energy.

NOTE.

The only comment which I have to make on Dr. Montgomery's argument is this: that, while denying that conspicuousness can control energy (matter), he admits that matter controls consciousness. These two positions are logically inconsistent. If the affirmative is true of consciousness it is true of matter, and *vice versa*. On other points I can agree fully with Dr. Montgomery.—*E. D. Cope.*

III. CONCLUSIONES.

1. The function of control and construction displayed by the energy of evolution (bathmism) leads us to infer that this type of energy can control its conditions sufficiently to enable it to have a wide distribution in space and time in the universe.

2. Since the originating and controlling element of this *special* type of energy is consciousness, it is inferred that consciousness has existed prior to any given *special* inorganic type of energy.

3. As the condition of consciousness is the unspecialized or uncreated condition of energy, it is inferred that consciousness is a property of matter in an unspecialized or generalized condition in some respect.

4. Since protoplasm is not in all respects the most generalized conceivable condition of matter, it is inferred that there are physical bases of consciousness other than protoplasm.

5. It is inferred from the preceding considerations that the existence of primitive consciousness in primitive forms of matter is not only possible but probable, and this consciousness constitutes a primitive person or Deity.—*E. D. Cope.*

Summary of the Controversy between Professor Cope and Myself.—Professor Cope maintains that mind is the active agent in the organization of living beings. I maintain, on the contrary, that the mind of living beings is itself only a product or outcome of their organization.

Professor Cope's view leads him to assume as original building-material an entirely "unspecialized" kind of matter, and as builder or organizer a supreme mind or Deity inherent in such matter.

In this connection I had to point out the great dilemma of modern philosophy; the impossibility, namely, of conceiving anything mental imparting motion or direction to anything material. Leading thinkers, of almost every school, when seriously contemplating the apparent occurrence of an intercommunication between mind and matter, have declared it scientifically impossible and philosophically inconceivable. Yet, Professor Cope's entire theory of organization through mental agency rests on the flat assertion of its being a self-evident proposition, that our mind moves our body.

I further pointed out that to escape from this distracting dilemma of having on the one side a mind incapable of *naturally* acting upon matter, and on the other side matter incapable of *naturally*

acting upon mind—that to escape this dead-lock in the way of a unitary or monistic conception of nature, a theory of cognition is indispensable.

By help of such a theory we become irrefragably aware that matter and motion are only perceptual signs within our own consciousness of the presence of a non-mental existent and its activity, which are stimulating our senses in specific ways. We can be certain that what thus effects our senses is really *non*-mental in its nature; for nothing mental has power to affect our senses and to awaken specific percepts in us. This non-mental existent and its activity cannot possibly, in the remotest degree, resemble their perceptual representation in us; for how can anything non-mental resemble anything mental? Therefore, they are not in themselves what we perceptually know as matter and motion. And thus the conception of mind moving matter becomes at once irrelevant. The dualistic opposition of matter and mind is seen to be superficial, and only due to inadequte conception on our part.

These truths, yielded by the theory of cognition, I have used to explain our voluntary movements, upon which movements the entire question of the influence of our "mind" on our body actually centers.

Our veritable being has power so to affect the sensibility of an observer as to arouse its perceptual representation in him. This perception of the observer, in all its details, forms clearly part of his own consciousness; but it representatively corresponds to the characteristics of the non-mental existent, which is stimulating his senses.

Now, it is evidently the *transient activity or function* of that part of the *permanent living being* which we perceive as his nerve-system that yields to him all his conscious states.

While this functional play of inner awareness is taking place in the observed organism, the observer himself perceives nothing but motion; motion of molecules in the nerve-system, and dependent movements of peripheral parts of the organism, such as features and limbs.

"Mind" or consciousness is thus a functional outcome of the organization of living beings, and its development is found to keep strict pace with the progressive organization of living forms.—*Edmund Montgomery.—From Open Court, Chicago, March* 1, 1888.

The Red Fox at School.—Nearing Ashland, Wisconsin, one May day, an Indian lad boarded the train with a basket, in which were three little red foxes (*Vulpes rufus*), their eyes just open, and handsome as little fairies. He expected a bounty for their scalps, but quickly sold one little fellow to me. Too young to know what danger was,—only as an inherited instinct, I determined to see how far he would yield to kind treatment and general domestication.

Returning to my Illinois home, he was fastened by a light chain about fifteen feet long to a pine tree near the back door. Two small dry-goods boxes, placed one above the other, with a door in the same end of each, served as a two-story kennel, the doors facing the house affording ample opportunity for observation. Too young to eat readily, we taught him to drink milk, and gradually to take tender meat, his teeth being at this time only tiny points, weaker—relatively, than a puppy's of similar age. He grew rapidly, and when feeding we held him in our laps, fondling him as a kitten, allowing him to lap and chew our fingers freely. Our shoulder came to be a favorite seat, and until too large, he liked a step still higher; later, to put his fore feet up, then repeatedly to jump from our shoulders to the ground, as we sat upon the grass. He was equally at home in the house where he was given entire liberty. It was now time that he and the cat, with her two kits, should eat and drink together and from the same dish. Kitty, accustomed to having various animals introduced into her home for observation studies, quietly accepted the inevitable. While drinking milk, of which there was always plenty, no jealousy for individual rights appeared, but as the fox grew faster than the kits, and the plate of meat sometimes seemed meager for four, he would eat as fast as possible, snuff a little, as much as to say, "go away,"—give another snuff, and not being heeded, would gently pick up one of the kittens by the nape of its neck, and carrying it off a little ways, set it down, then rush back to the dish, to find the kit there also. This being repeated two or three times, with no satisfactory results, as if out of patience, he would grow more decided and inclined to hurt them a little, making them cry, but they were never conquered. When he had had enough, and a little comparatively was sufficient, if any meat was left, even of the size of a walnut, he would dig a hole, drop it in and with his sharp nose press it down closely, then cover it, and looking about, to be sure of no witnesses, would give a flirt of pine needles over the place, till one could scarcely detect the freshly stirred earth. "Cunning as a fox." If I attempted to find it, he would stand sentinel, and as the spot was neared give a snuff of dislike, but never in his life of nearly two years attempted to bite or bark, nor did we ever see him dig up any of these buried morsels. We tried the effect of raw and cooked meats upon his disposition and found him, after a few days on raw diet, inclined to lap heavier, and chew our fingers harder, but we never feared being bitten.

He greatly enjoyed playing with the kittens but they, being so much smaller and weaker, would tire more quickly and start off to play by themselves. An artifice was at hand to coax them back. Going nearly to the end of his chain, and facing the inside of the circle, though with a keen eye to the outside, he would quietly wag his tail back and forth in the grass. This motion was too great a

temptation for the kits who would chase it, when quick as a flash, he would turn and grasp one, without hurting it but with *such* a look of pleasure and conquest. This feat would be accomplished frequently till all preferred rest or another pastime.

An apple tree stood near the pine, and the young fruit fell freely. With these apples the fox would amuse himself by the hour, playing ball, tossing them and running after them, or tossing them up and catching them in his mouth, also chasing the leaves as they fell to the ground, but he never inclined to gather any materials to make a nest, nor to eat the sour apples.

For persons, he manifested great preferences, and the children who came daily to play with him were no exception. From some, he would take almost anything, especially enjoying a play with their hair as they lay in the grass with him, or to lick their faces and feet, from others he required due reserve, though he never attempted to bite, but often snuffed at them, and held his mouth slightly open, as a cat will, when some disagreeable odor is perceived. When a stranger appeared he was manifestly "foxy," running away as far as he could, and was not readily coaxed by dainty morsels, until some friend came, by whose manner he was assured. My aged grandfather was always kind to him, though in heart he accused him of possible treachery. Did the fox detect this, or why did he in turn always manifest a marked distrust in him? Like a dog, he recognized the foot fall of his friends at a long distance, and would start up and wait for their approach, manifesting great joy on their arrival.

That summer we had a coop of early chicks near the door and for their safety we feared, but soon found that as the fox was sufficiently fed at meal time, these were no temptation to him, and they could pick up crumbs in safety within his own circle.

On several occasions, in his gambols, he broke his chain. Indoors he was readily caught, but when loose out doors, he lost all judgment and did not recognize his surroundings. The yard being large with much shrubbery, to catch him was no trifle, and his instinct to "cover his track" became apparent, often leaping several feet to one side of his course, retracing his steps some distance, then leaping off to one side, or concealing himself behind a bush. When once caught and in our arms, or returned to the house, or his kennel, he could not sufficiently express his joy, lapping our hands and faces, rolling over and over, turning summersaults, etc., etc., in rapid succession. Never was a lost dog happier to find his home than the fox to find his.

At an early age he manifested a slight tendency to burrow, but always in the same place, by the side of his kennel, digging it out and filling it up again, but never, even as winter approached, did he make a space long enough for his body, nor deep enough to conceal himself, rather, only a shallow trench. Was this lack of

provision for the future a direct result of domestication? In summer he often lay in this hollow, but his favorite sleeping place, even in mid-winter was on top of the highest box, the wind playing generally in his long, thick and fine hair. Was this position and his love for sitting on our shoulders or any elevated place a remnant of some arboreal strain? At twilight and by moonlight was his play time, turning summersaults, rolling over and over, jumping from the second story to the first and then to the ground and back, or entirely over his kennel, etc., etc., but though always on the alert, we never noticed anything which indicated discontent or fear, only as strangers came near him.

We tried to teach him various tricks, but for these he developed little aptness, except to return a stick when thrown and to play hide and seek with the children, he appreciating the point quite as much from his standpoint as they from theirs, but a faculty for long continuance at such acquired games was wholly lacking in his nature. When in the house he paid little more attention to the tones of the piano than a dog, though when very rapid and loud numbers were executed he would look earnestly, but not anxiously. With singing and whistling he was always familiar, but the only appreciation he manifested of either was a glad recognition of the voices of his friends; to a scolding tone, or any reprimand directed to him he was very susceptible, closing his eyes as meekly as a dog when reproved. As he seemed to have attained his maximum in mental capacity, and the object of our study had been secured, the second winter he was passed over to the taxidermist; but for a pear, whenever the earth about the pine was stirred, the peculiar odor of the fox was evident, though in playing with him on the grass we rarely detected it.—*Mary E. Holmes, Ph.D.*, Rockford, Ills.

Canine Dissimulation.—Mr. John F. Stafford, of Chicago, owns an English Bull Terrier about two years old. "Shave" is indulged considerably by his master, and occasionally allowed to remain indoors if the weather is bad.

Once Shave had a severe cold and coughed considerably, during which time he was allowed to stay in the house.

Since his recovery when any mention is made of turning him out of doors he coughs vigorously, and wheezes, in fair imitation of asthma.

The trick does not avail him now, however, but he recollects that it did once. When put out he drops the pretence at once and dashes gaily off after neighborhood company.

Shave's mother, it is said, used to ring an electric bell by pressing upon the button in the floor when she wanted to go out. There is a chance for this to be accidental, but the family believe that it is intentionally done. The coughing trick I witnessed once in Shave, and Mr. Stafford says it is often resorted to by the hypocrite.—*S. V. Clevenger.*

ARCHÆOLOGY AND ANTHROPOLOGY.[1]

THE LATE DISCOVERIES OF MR. FRANK CUSHING IN ARIZONA. — Mr. Frank Cushing is well known to the people of the United States for his discoveries and studies among the Zuni Indians. He has added another chaplet to his wreath of fame by the discovery of two other Indian cities, believed by him to have been the habitation of the ancestors of the Zuñis. Mr. Cushing joined the tribe of Zuñis, was adopted by them, and finally was initiated into the order of their priesthood. His escort of a band of Zuñi chiefs and high priests to the States to show to them the Atlantic ocean, the sea of the sunrise, containing the water of life, is well known. His knowledge and information obtained through these long years of intercourse has equipped him for further study and search, and has enabled him to secure success where other men merely book-learned would have failed. He is fairly entitled to the credit of his last achievement.

The Locality. — To visit the scenes of Mr. Cushing's present discoveries, the traveller should take the Southern Pacific Railway, descending at Maricopa, Arizona, about midway between Tucson and Yuma City; from thence a small branch railway, Phœnix and Maricopa Railroad, will take him northeast to Tempe, twenty-five miles. At Tempe by private conveyance to Mr. Cushing's camp, which will be in the neighborhood within ten miles. While at Tempe in the spring of 1887, Mr. Cushing heard of a large truncated mound in the desert six or seven miles to the southeast.

The Discovery.—He visited it, and with that apparent intuition which seems to have been the foundation of his success, he declared it to be of artificial formation, and that it would be found to contain evidences of its construction by man. His workmen were brought from Tempe, who in a marvellous short space of time brought to light the ruins of an immense building. This Mr. Cushing decided to have been used as an Indian temple and for other purposes. He remarked many things which corresponded in a remarkable degree with the Zuñi religion, and which he was able to recognize by reason of his priestcraft. Such a temple, he argued, was part of a great city. He continued his explorations with the result that by the autumn he had discovered a city three miles long and at some places one mile in width. This city was somewhat irregularly laid out, consisting principally of large squares or blocks of houses surrounded by a high wall, apparently for protection. The cause of the ruined condition of the city and its desertion by the inhabitants was determined to have been an earthquake. The adobé walls were shaken at their foundation, and fell outwards. The roof had fallen to the floor crushing everything which had been in the house, in one case the cooking vessel as it sat upon the fire. This evident sud-

[1] This department is edited by Thomas Wilson, Smithsonian Institution, Washington, D. C.

denness of the catastrophe was a factor in forming the belief that there had been an earthquake. The implements of the household and articles in every-day use have been found in many places, and saved. Their examination will afford opportunities for studying the every-day life, and writing the history of these prehistoric people. Many bodies have been found crushed in the débris of the fallen roofs and walls. Many interments have also been discovered. Some were by inhumation, and these were believed to be priests. And herein comes the value of Mr. Cushing's knowledge as a Zuñi priest. These burials were usually made within the houses themselves. The grave was dug in the earth forming the floor, the body placed therein together with the usual articles, receptacles for food, pottery, etc., and being filled up, the floor would soon take its original hardness. The objects thus found interred formed the principal evidence of the priestly character of these dead. The pottery was decorated similar to the modern Zuñi pottery. The same symbols were to be seen thereon. The line of life always open at its extremities was continually present. And referring again to the Zuñi religion, the pottery was left unbroken.

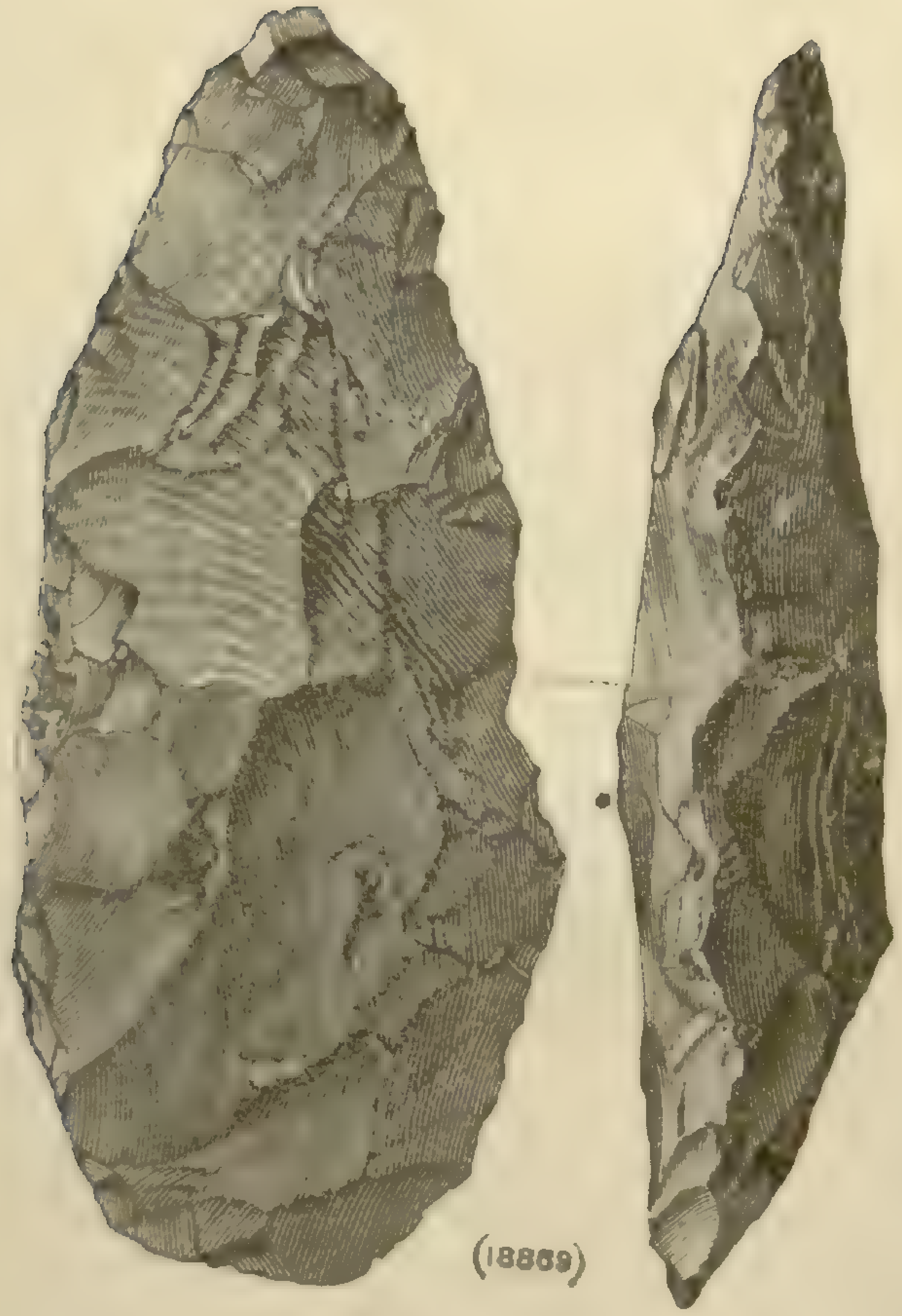
Other cemeteries or graves were found outside the walls. These were of common people, had no traces of priestly character, were frequently by incineration as inhumation, and the vessels accompanying them were always broken. No object in metal was found. This locality, in the midst of an unbroken plain, was without name. Mr. Cushing has named it for identification, *Los Muertos*, The City of the Dead.

Mr. Cushing has discovered another city or town, distant ten or fifteen miles from Los Muertos, being seven or eight miles northeast from Tempe. This has not been excavated to such an extent as has the first, but he finds extensive works for irrigation. Ditches have been cut connecting it with the Salt River, some miles distant, for the conduct of water. For this reason he has named it *Las Acequias*.

Dr. Washington Matthews, Surg. U. S. A., of the Army Medical Museum, visited Mr. Cushing at the scene of his discoveries during the past fall. He found him much broken in health, and sadly in need of rest. Dr. Matthews prescribed for him, relieved him from his duties, and took him to San Diego, to recuperate.

The number of skeletons could scarcely be estimated, but their state of preservation was fairly good, yet requiring care and scientific handling in order to secure them. The finds in this direction have been sufficiently large in number and importance to justify the Museum in sending one of its assistants, Dr. Wortman, charged with the necessary material, who will devote himself to the care and preservation of the skeletons as they are unearthed.

Dr. Ten Kate, a distinguished archæologist of Holland, passed through the City of Washington on his way to join Mr. Cushing.



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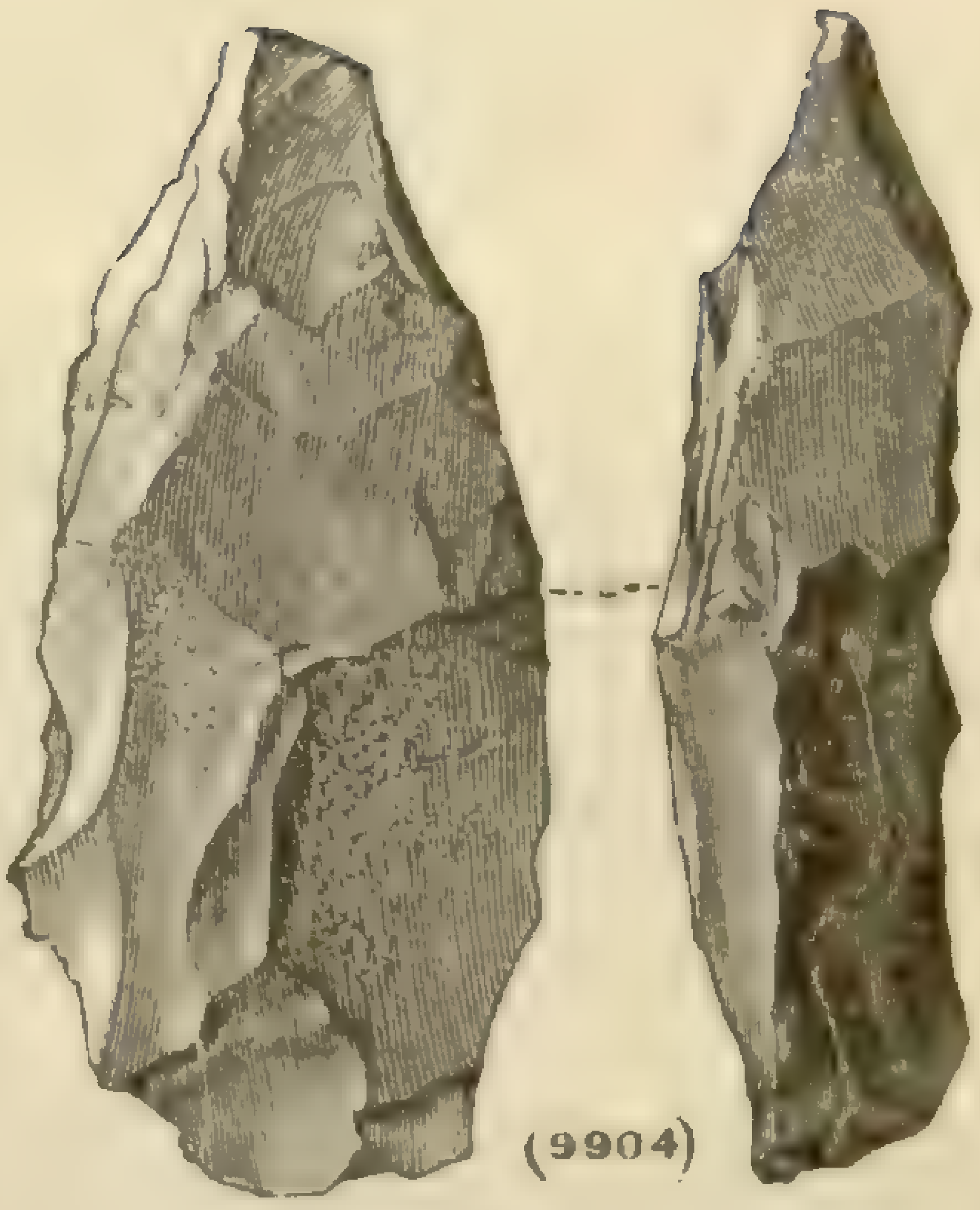

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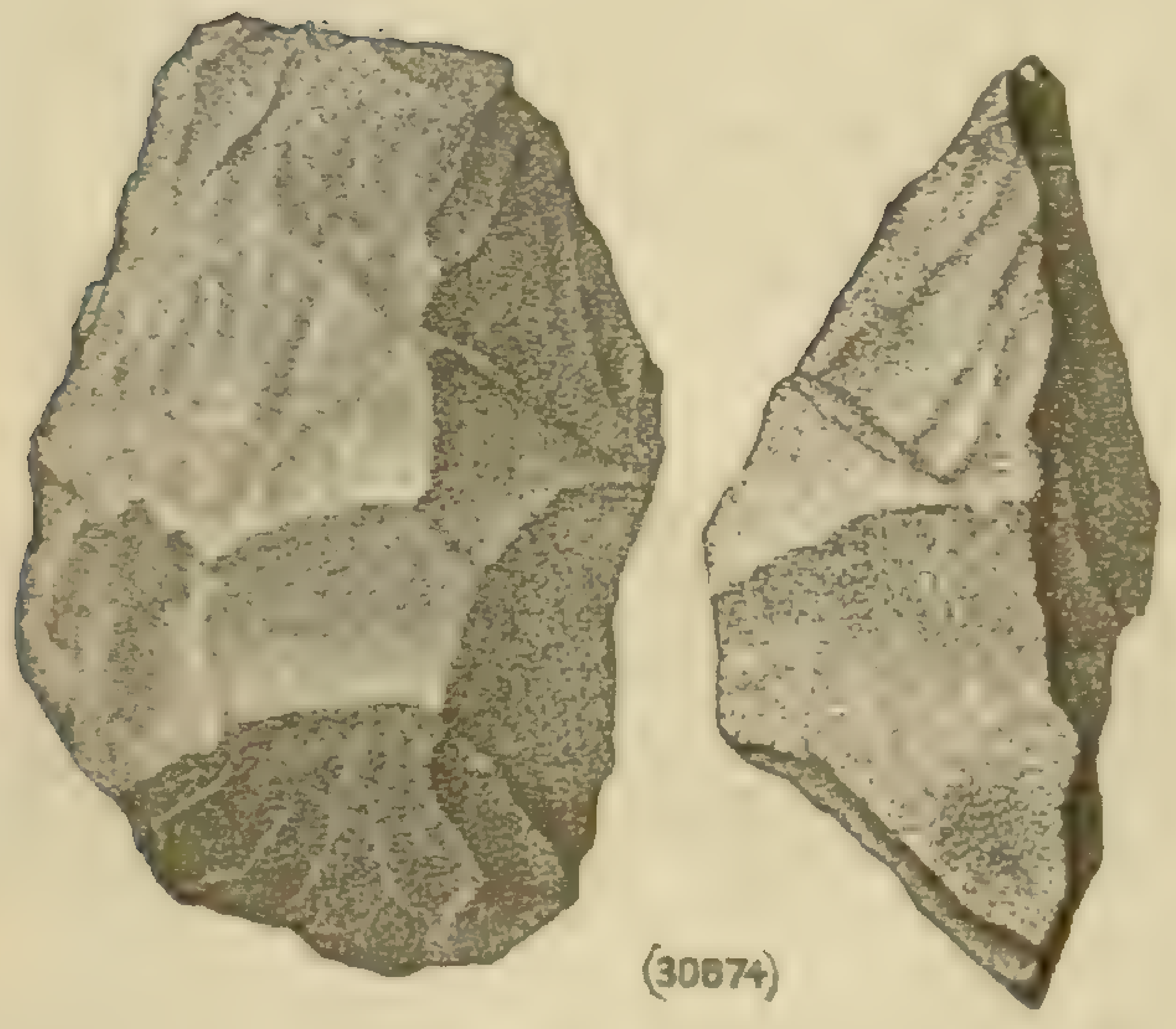

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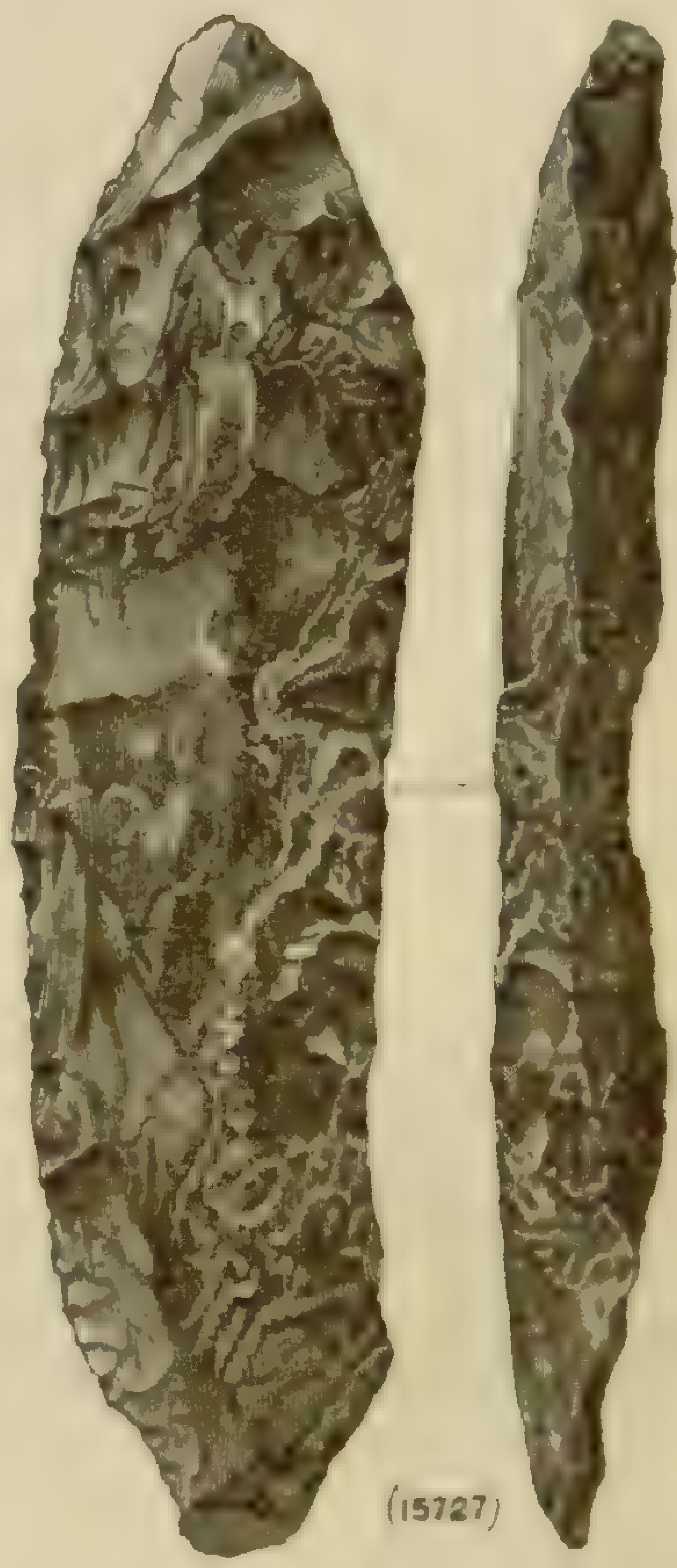

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CALIFORNIA.
W. G. HARFORD.

He will remain there, assisting Mr. Cushing in his work during the present winter.

The funds for the expedition are furnished by Mrs. Augustus Hemenway, of Boston.

THE CELTIC SOCIETY OF MONTREAL has recently published an octavo volume of 231 pages, containing some of the papers read before the society during the years 1884 to 1887; to judge from their names, the office-bearers, and perhaps the other members also, are all of Scotch descent. The publisher of the volume, called "Transactions of the Celtic Society," is Mr. William Drysdale, and among the "office-holders" we find also a *bard*, Mr. Archibald Mackillop. The constitution states that the object of the Society shall be the promotion of the study of the "Celtic Language and Literature." The society was organized in December, 1883, and now counts 250 members, many prominent Canadian statesmen among them. Celtic history, folklore and the literature of European States are not the only object of the society, for it also strives to gather and publish all information to be obtained on Celtic settlements in Canada from Nova Scotia to Vancouver Island. Many of these seem to be of an extremely migratory character. The first article is "On the monumental evidence of an Iberian population of the British Islands," and a second one, by the same author, embodies "A translation of the oldest Celtic document extant, and of its Etruscan companion," pp. 159–229, by Professor John Campbell. This Celtic document is nothing else than the seven bronzes, tablets of Gubbio, discovered in 1444, translated and interpreted by Aufrecht and Kuhn, as a sort of ritual of the temple of Jupiter Grabovius at Iguvium (Gubbio) in 1851. But Professor Campbell is by no means satisfied with this interpretation. He finds that the Umbrian language of these tablets is of the *Celtic family*, and that they contain the narrative of a revolt of the colonies of Umbrians and Etruscans in the plains of the Po River, and forthwith proceeds to give a new translation of the tablets, which is probably three times as long as the originals themselves. He states that Upper Italy was then filled with Iberian and Pictish tribes, that Iguvium, the capital, was held by the *eis o Feinne* or Fenians, and that this revolt occurred anno 178 before Christ. The other papers refer to more tangible facts or events of modern times, as "The settling of Glengarry," the "Celt in the Northwest," "Sketch of the Manx language," "Origin of Scottish Highlanders," etc.—*A. S. Gatschet.*

RELIGIOUS BROTHERHOODS OF MOROCCO and the superstitions prevailing among these were made the subject of a communication by Dr. Henry ten Kate to the *Berlin Anthropologic Society* (session of June 18, 1887). We find there: the superstition of the

horse-shoe, that of the protection effected by the outstretched hand, by rags suspended on tree-limbs, the belief in miracle-working springs and fountains, the swallowing of fire, etc.—*A. S. Gatschet.*

GUANAJUATO.—The statistics of this Mexican State, which borders on the west side on Jalisco and Zacatecas, were made the subject of a quarto publication by Antonio Peñafiel, the director of the statistical bureau in Mexico. The title is *Cuadros sinopticos y division territorial de la Republica Mexicana. Estado de Guanajuato.* Mexico, 1887, pp. 192, 4°. This central state has an area of 20,276 square kilometres. The district in which the capital is situated, lies about 2000 metres above the ocean. The State has 1,007,116 inhabitants, the capital, Guanajuato, 52,112. The Indian languages spoken in the State are the Pame, Otomi, Chichimec, Tarasco and Jarapecha, which is a Tarascan dialect.—*A. S. Gatschet.*

Lieut.-Gen. Pitt-Rivers, of the British Army, is known to archæology as well under his former name, Col. Lane-Fox, as under his present name. Upon the decease of an elder brother, he took, as the next heir, the entailed family estates, and by provision of the entail was required to change his name as above. The family estate was at Cranborne Chase, not far from Salisbury. Here Gen. Pitt-Rivers had ample scope to indulge his archæologic tastes in excavations. He has profited by the occasion, and has lately published for private distribution a magnificent quarto-volume, entitled "Excavations in Cranborne Chase, near Rushmore, on the Borders of Dorset and Wiltshire." He has continued his investigations, and read before the Anthropological Institute at London an article in continuation thereof. His article is followed by one of Dr. Beddoe's, which pursues the same line of thought. Both are largely devoted to a calculation of the stature of the prehistoric races, as estimated from the long bones of the skeletons found in the tombs.

The rules adopted by the different authorities eare commented upon in the light of experience by these two gntlemen. They belong to the science of anthropometry, and it would increase the length of this article beyond proper limits to give them. The importance of anthropometry is better recognized in Europe than it has been in the United States, which is much to our detriment. Gen. Rivers says: "I draw the attention of anthropologists to the important point than questions of stature enter so largely into all racial speculations that a uniform system of estimating stature from the long bones is a matter of most ungent necessity." Again, "I have conformed to Dr. Topinard's rules for the sake of uniformity, and in this I am supported by Dr. Garson.

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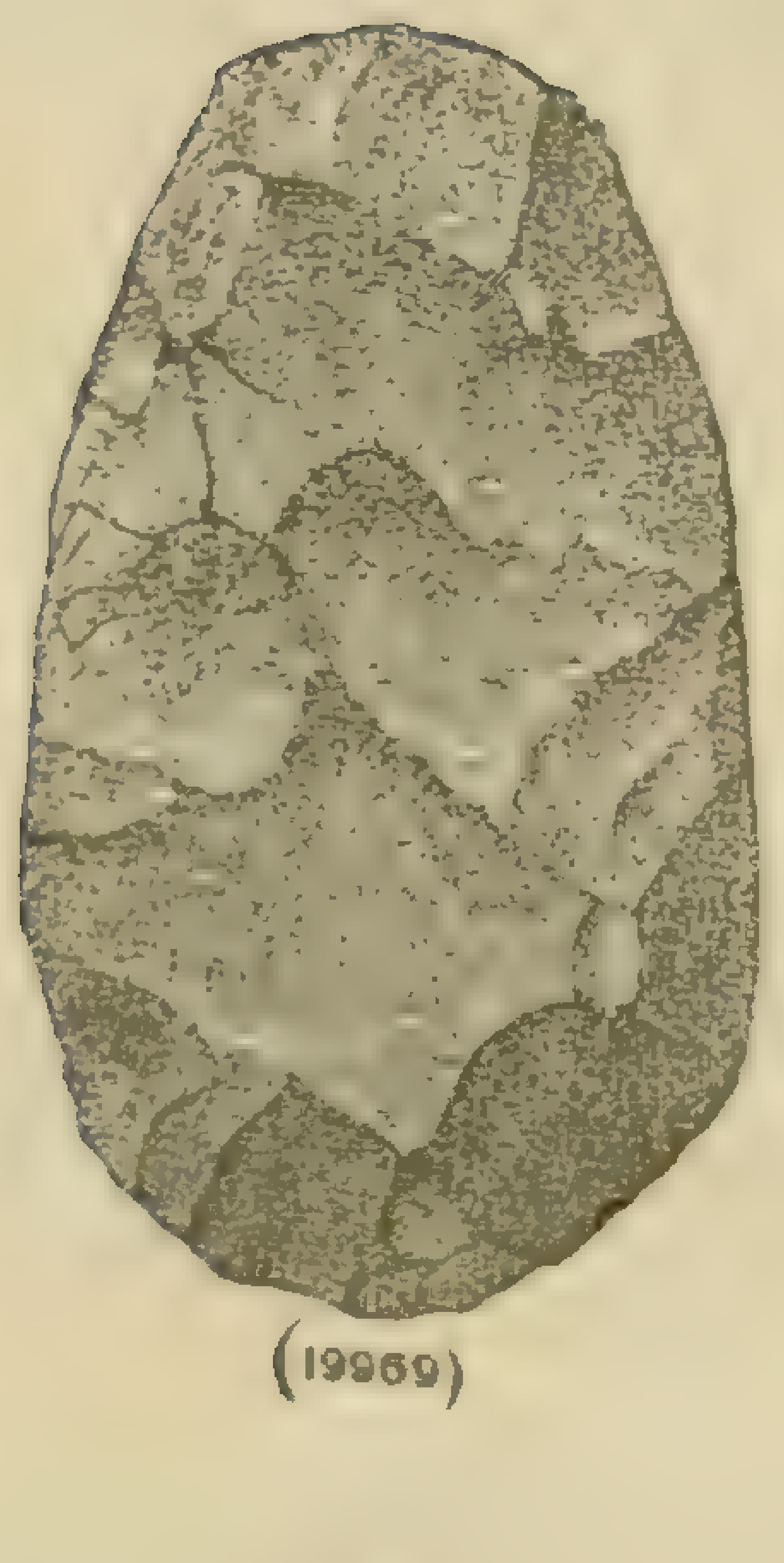
DISTRICT OF COLUMBIA.
JAMES WEBSTER.



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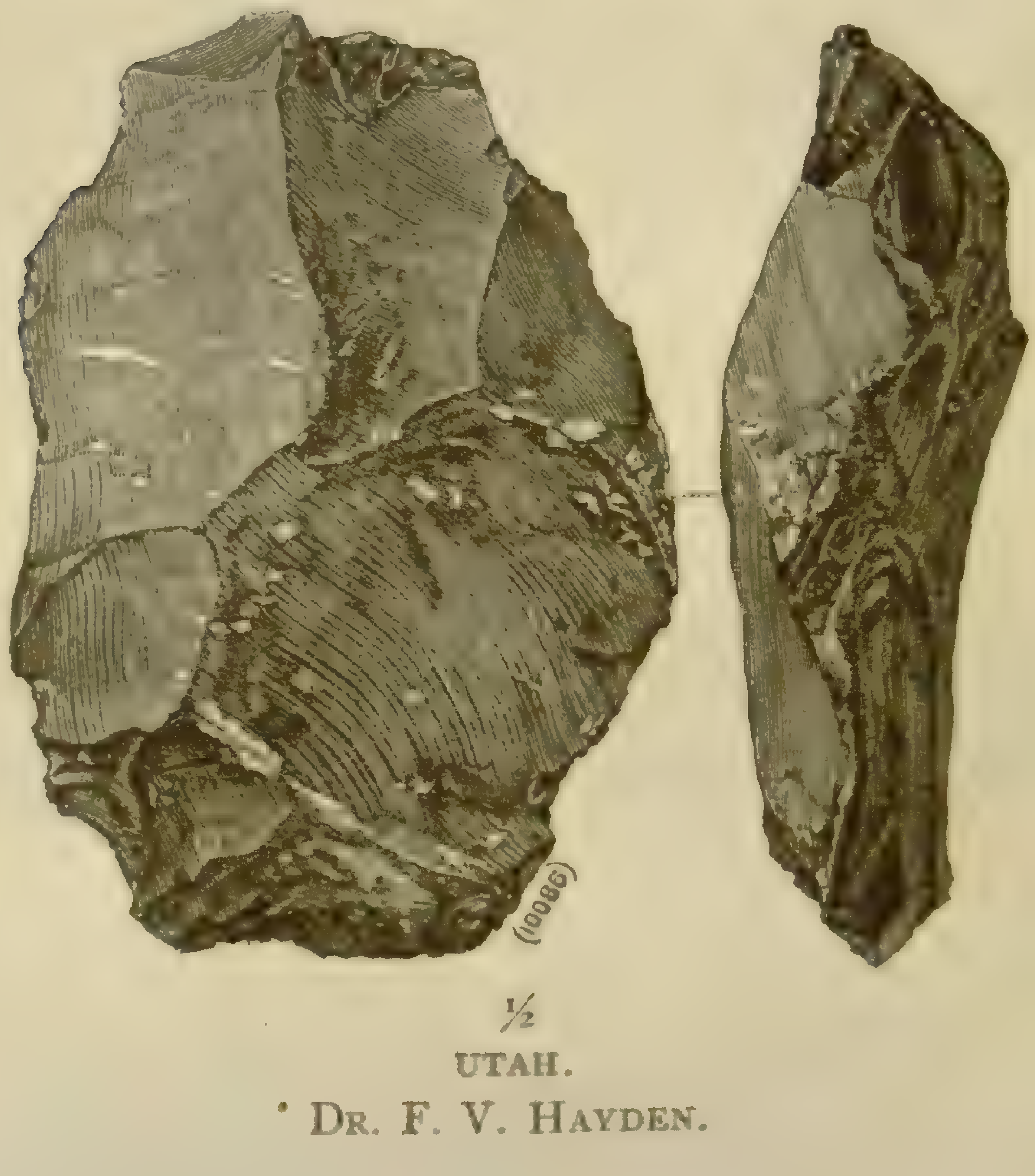

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"Dr. Topinard's method, even if it should not turn out to be the best, appears to me sufficiently reliable to serve as a generally accepted standard."

Other articles in the journal of the Anthropological Institute are the Lower Congo; a Sociological Study, by Richard Cobden Phillips; and The Origin and Primitive Seat of the Aryans, by Canon Isaac Taylor.

The Smithsonian Institution has issued the following Circular (No. 36) concerning the Department of Antiquities:—

The Smithsonian Institution desires answers to the following questions concerning that class of American Aboriginal Stone Relics which have been heretofore denominated "rude or unfinished implements of the paleolithic type."

These implements are described by Dr. C. C. Abbott in "Primitive Industry," chap. xxxii., p. 471; by Professor F. W. Putnam "Remarks upon Chipped Stone Implements," from the Bulletin of the Essex Institute, vol. xv., 1883; by Mr. A. F. Berlin in American Antiquarian, vol. i., No. 1, p. 10; by Miss Frances Babbitt in Proceedings of American Association for the Advancement of Science, vol. xxiii., Minneapolis meeting, Aug., 1883, p. 385.

Cuts of some of these implements are herewith given.

QUESTION I.—How many of these rude stone implements have you in your collection?

QUESTION II.—Do you know of any in other museums or collections?

QUESTION III.—Of what material are they made?

QUESTION IV.—Where have they been found?

1. As to locality.
2. Position, condition and associated with what objects?
3. Whether on or under the surface, and, if so, at what depth, and in what kind of geological formation?
4. Were they found in mounds, tombs or other ancient structures?
5. Were any other ancient implements found with them, and, if so, of what kind?
6. Did their deposit seem to be accidental or intentional?
7. Have they been described in any publication, and, if so, in what, and where can it be obtained?
8. Can you forward specimens (as many as possible) to this Museum in exchange for publications or duplicate specimens?

—*S. P. Langley, Secretary Smithsonian Institution.*

MICROSCOPY.[1]

Plaster Tablets for Mounting Anatomical Preparations.—Mr. H. Garman, of Champaign, Ill., finds tablets made of plaster preferable to most others for mounting anatomical preparations. The following communication on this subject has been received from Mr. Garman:—

"My experiments with this material were made without knowledge of its use for the purpose in other quarters, and I was surprised to learn, upon inquiry, that the large white tablets used for ordinary alcoholic specimens in the Museum of Comparative Zoology were of plaster, and had been cast upon glass. However, I believe the manner of making them, and the facility with which they can be produced, is not as generally known as it should be, and that, as my results were reached independently, the details of the method here given may prove of service even to those who are accustomed to the use of plaster. I do not know that colored plaster tablets have been used by others.

"The tablets are made by mixing good plaster of Paris with water until the mixture is of the consistency of thick cream. It is then poured upon plates of glass, and after it has "set" the tablets are roughly marked out with a knife blade. In about twelve hours they can be taken from the glass and trimmed more exactly with the aid of a ruler. They can be made of any desired thickness, and when fully hardened are sufficiently strong to endure the handling to which they are liable. The soft plaster may be spread uniformly and its upper surface be made smooth by taking the glass bearing it between the hands, and moving it abruptly from side to side a few times. If, after the tablets have become dry and hard, it is desired to trim them, or to alter their shape, it can readily be done with a knife after first soaking them in water.

"Dissections or other objects are fastened in position with thread passed, by means of a needle, through the edges of the object, or around some part of it, and tied at the back of the tablet. Or holes may be drilled through the tablet and the thread be secured after passing through them.

"Common prepared bluing is a good coloring material, and mixed with plaster in proper quantities can be made to give a range of hues from blue-gray to deep blue that, with the pure white of uncolored plaster, satisfies most needs in the way of backgrounds. Black ink and carmine staining fluids can be used to stain the white tablets. But the latter color is not often a desirable one, and if it is to be used can be more economically applied by first dissolving carmine in water with heat, then adding the plaster, finally casting

[1] Edited by C. O. Whitman, Director of the *Lake Laboratory*, Milwaukee.

upon glass. Lampblack will not, in its ordinary form, mix with plaster. A variety of colors may be obtained by using the 'Florentine Fresco Colors' sold by F. W. Devoe & Co., New York. They may be mixed with the plaster. The chrome orange, chrome yellow, Venetian red and ivory black have been on trial in tablets for about a week, and show no change under the alcohol.

"The use of plaster in tablets is not claimed to be new with the writer, but this method of manipulation and coloring is the result of independent experiment, and may therefore present some features of interest. Tablets as above prepared have proved, in my experience, superior to those made of wax in the matter of cost, in the facility with which they are to be prepared, and in neatness of appearance."

PREPARATION OF THE EGGS OF ASCARIS MEGALOCEPHALA.—Through the researches of M. Nussbaum,[1] Ed. van Beneden,[2] J. B. Carnoy,[3] and Otto Zacharias,[4] the egg of *Ascaris megalocephala* of the horse has become a classical object for the study of fecundation. In the simple structure and enormous size of its nuclei, this egg offers unequalled advantages for such study. But a very serious drawback is found in the thick impervious egg-membrane, which is capable of resisting for a long time the action of preservative reagents. Dilute acetic or nitric acid requires at least from eight to ten days to penetrate; and alcohol of 40 to 50 per cent., two or three months. Development goes on undisturbed in osmic acid of 1 per cent.; and several days are necessary even for absolute alcohol to take effect.

For tracing the karyokinetic phenomena of fecundation, it is of the utmost importance to find reagents that will kill and fix quickly, as reliable preparations of transitory stages in nuclear metamorphosis cannot be expected with reagents that penetrate slowly.

Otto Zacharias[5] has discovered an acid mixture which overcomes the resitence of the egg-membrane, and fixes the egg completely within 25 to 30 minutes. The mixture consists of

Alcohol (90 to 100 per cent.)	80 ccm.
Glacial acetic acid	20 ccm.
Osmic acid (1 per cent.)	20 to 30 drops.

A little glycerine or chloroform increases the clarifying power of the mixture.

[1] Archiv f. mik. Anat., xxiii., 1884.
[2] Archives de Biol., iv., 1884.
[3] La Cellule, 1886-7.
[4] Archiv f. mik. Anat., xxx., H. 1, 1887.
[5] Ueber Abtödting und Färbung der Eier von Ascaris megalocephala. Anatomischer Anzeiger, iii., 1, p. 24, Jan., 1888.

Van Beneden (*Nouvelles Recherches sur la fécondation, etc.*, 1887) has employed a stronger mixture, consisting of absolute alcohol and acetic acid in equal parts, without the addition of osmic acid.

Preparation of Material.—1. Freshly obtained[1] Ascaris females are placed between two sheets of cotton, which have been moistened a little in a 3 per cent. solution of common salt, then covered with a bell glass, and exposed one to three hours to an incubation temperature of 25°C. This procedure brings the polar globules to development in the younger eggs, and forces the cleavage in the older eggs.

2. After an hour's incubation, it is well to preserve a part of the material at disposal. The genital sacks are laid bare by a longitudinal slit in the body-wall, opposite the sexual aperture; the vagina is then cut free from the body, the alimentary tract lying between the two sacks is carefully removed, and the ovarian portions of the sacks are cut off, leaving the uterine portions with their contents for preservation. The anterior ends of the uteri contain eggs in all stages of maturation and fecundation; the posterior ends contain eggs already beginning to cleave. The killing and hardening process should vary considerably for these different stages.

3. It is advisable, therefore, to cut each uterus into thirds, and to expose the anterior third to the action of the acid mixture only five to seven minutes, the middle third ten to fifteen minutes, and the posterior third at least twenty-five minutes. After fixation, the anterior and middle thirds are transferred to 30 per cent. alcohol, and after a few hours to 50 per cent. alcohol, in which they may be kept for a long time. Eggs in process of cleavage—found in the posterior third—should be removed to absolute alcohol the moment they begin to show a light brown staining. After two to three hours they are to be transferred to 70 per cent. alcohol for preservation. If the acid mixture be heated to about 24°C., the posterior third of the uterus will require an exposure of only ten to fifteen minutes.

4. *Schneider's acid carmine* is an excellent staining agent. It is prepared as follows: Glacial acetic acid is diluted with distilled water to about 50 per cent.; then as much pulverized carmine is added to the boiling acid as will dissolve. After filtering until the fluid becomes clear, a little rectified wood-vinegar is added (one drop *A. pyrolignosum* to ten ccm. of the carmine solution) for the purpose of strengthening the clarifying power of the mixture.

The younger stages may be left in the dye three to four hours, the older stages eight to ten hours.

Beautiful views of the karyokinetic figures are thus obtained, but they are not permanent. After three to four hours they begin to lose in distinctness.

[1] From the living horse, by means of arsenic pills.

Grenacher's alcohol carmine gives more durable preparations. Eggs thus stained may be improved by treatment with *methyl green* (2 per cent.), to which has been added a few drops of glycerine. The spindle-fibres of the first and second amphiasters may be most successfully stained with "Modebraun," in very dilute aqueous solution. Preparations are mounted in dilute glycerine (glycerine two parts, distilled water one part).

SCIENTIFIC NEWS.

—The *Journal* of the Royal Microscopical Society has just completed its first decade, and the last number of its tenth volume contains an editorial "preface" by the editor, Mr. Frank Crisp, paying a deserved tribute to his associate editors and especially to Professors F. Jeffrey Bell and A. W. Bennett, who for these ten years have prepared those abstracts of the biological literature of the world which have made the Journal indispensable to every naturalist who wishes to keep up with other subjects outside his specialty.

—George W. Tryon, Jr., the Conchologist, died in Philadelphia February 6th, aged fifty years. Although not a Friend, his education was gained at Friends' school, and at an early age he engaged in business with his father and brother. The lack of collegiate education he amply made up in later life by private study. His early years were devoted assiduously to his business and to his studies, and his attention having been concentrated on natural history, and especially on the study of shells, he withdrew in 1867 from business in order to devote himself solely to his favorite pursuit. A man of untiring energy and perseverance, he soon became eminent in this domain of science. His first paper was published in the proceedings of the Academy of Natural Sciences for 1861, under the title "On the Mollusca of Harper's Ferry, Virginia." In 1865 he established the "American Journal of Conchology," of which seven annual volumes were issued. To this, and to the proceedings of the Academy he contributed numerous papers, numbering at the end of 1873 no less than sixty-four contributions to this favorite science, all showing characteristic accuracy of detail and patient research. In addition to these papers he also issued a Bibliography of American Writers on Conchology in 1861; a Monograph of the Fresh Water Univalve Mollusca of the United States, in continuation of Haldeman's work on the same subject; a Synonymy of the Species of Strepomatidæ in 1865; a Monograph of the Terrestrial Mollusca inhabiting the United States, 1866; an American Marine Conchology, 1873; the third volume of the Land and Fresh Water Shells of the United States, published by the Smithsonian Institution, and a Structural and

Systematic Conchology, in two volumes, issued in 1883. The latter is a magnificent work, profusely illustrated, but was only preliminary to the crowning work of his life, which, unhappily, he has been unable to finish. This was his Manual of Conchology, Structural and Systematic, of which the first volume appeared in 1879, and of which nine volumes of the first series, on marine shells, and three of the second, on land shells, have been issued. It is no exaggeration to say that this is the most extensive systematic work on any branch of natural science which has yet appeared in the United States. The collection of shells of the Philadelphia Academy of Natural Sciences was largely his gift to the institution, and it was one of the largest in the world. The library of this institution is also one of the most complete in the world on this subject, chiefly through Mr. Tryon's exertions. Mr. Tryon was also well known in musical circles. He edited for Lee & Sheppard a pamphlet series of operas, which is very popular, and essayed on several occasions original music work, including an opera.

—Asa Gray.—Born in Sauquoit, Oneida county, N. Y., November 18, 1810. Died in Cambridge, Mass., January 30, 1888.

When a great man dies, it is fitting that his survivors should recount his deeds, and learn the lessons which his life and labors teach. Born in the poverty and obscurity of a backwoods village, far from any of the great centres of learning, there was nothing of promise in the future for the little tanner boy of the Mohawk Valley. When he urged the unwilling horse on his tiresome round, and wearily labored at his monotonous task of feeding the bark-mill, who could have foretold his after greatness? What prophet could have seen in the village school-boy, so far removed from all incentives to the study of science, the future leader of one of the great branches of science in America?

Denied the advantages of a collegiate education, he completed, at the age of twenty, the study of medicine in the Fairfield College of Physicians and Surgeons for the Western District of New York, and doubtless the scientific studies of the course had much to do with making him what in his after life he always was, emphatically a scientific man. His botanical work began during his study of medicine, and by the time of his graduation he had already done something in the way of collecting and identifying the plants of his locality.

The great event of the young botanist's life was his meeting, when twenty-one years of age, with Dr. John Torrey, then teaching in New York City. Under the inspiration of Torrey, his studies were led into those lines of work in which his life was destined to be spent. In his herbarium and by his help Gray's first botanical contribution (viz.: "North American Gramineæ and

Cyperaceæ") was wrought out. In the introductory note to part I, which bears date of February 1, 1834, acknowledgment is made of the author's obligations to Torrey "for the interest he has taken in his botanical pursuits, for the important aid he has rendered him in the determination of doubtful species, and for the use of his valuable library and herbarium."

In his twenty-ninth year Dr. Gray visited Europe, and made the acquaintance of many of the great botanists of that time,—the elder and the younger Hooker, Bentham, Greville, Robert Brown, Lindley, Mirbel, Decaisne, St. Hilaire, Boissier, Adrien de Jussieu, Endlicher, Von Martius, the De Candolles, Schlechtendal, Kunth, Ehrenberg and many others.

Three years later he was called to the chair in Harvard College, which he filled for thirty-one years, until relieved of the drudgery of teaching in 1873. When sixty years old he was elected president of the American Association for the Advancement of Science, at the meeting held in Troy, and two years later delivered his famous address, "Sequoia and its History," at Dubuque.

Upon the anniversary of his seventy-fifth birthday the botanists of the country united in a testimonial of respect and veneration to the one on all hands acknowledged to be their leader. Last year, on his revisiting England and Scotland, the Universities of Oxford, Cambridge and Edinburgh, honored themselves as well as him by conferring upon him their highest degrees.

The activity of his mind throughout a long life may be indicated by the following list of the more important of his publications, with the age at which they were issued:

At 24.—North American Gramineæ and Cyperaceæ.

At 26.—Elements of Botany.

At 28.—A Flora of North America (in conjunction with Dr. Torrey).

At 32.—The Botanical Text-Book.

At 35.—The Botanical Text-Book. Second Edition.

At 36.—Chloris Boreali-Americana. Decade I.

At 38.—A Manual of the Botany of the Northern United States.

At 38.—The Genera of the Plants of the United States, illustrated by figures and analyses from nature.

At 40.—Plantæ Wrightianæ Texano-Neo-Mexicanæ. Part I.

At 40.—The Botanical Text-Book. Third Edition.

At 42.—Plantæ Wrightianæ Texano-Neo-Mexicanæ. Part II.

At 44.—Botany of the United States Exploring Expedition.

At 46.—Manual of the Botany of the Northern United States. Second Edition. [Extended so as to include Virginia, Kentucky and all east of the Mississippi.]

At 47.—First Lessons in Botany and Vegetable Physiology.

At 47.—The Botanical Text-Book. Fifth Edition.

At 48.—How Plants Grow.

At 49.—The Relations of the Japanese Flora to that of North America.

At 57.—Manual of the Botany of the Northern United States. Fifth Edition.

At 58.—Field, Forest and Garden Botany.

At 62.—Sequoia and its History (President's Address, A. A. A. S.).

At 62.—How Plants Behave.

At 66.—The Gamopetalæ of the "Botany of California."

At 66.—Darwiniana.

At 68.—Synoptical Flora of North America. Gamopetalæ after Compositæ.

At 69.—Botanical Text-Book. Sixth Edition.

At 70.—The Vegetation of the Rocky Mountain Region (in conjunction with Joseph D. Hooker).

At 74.—Synoptical Flora of North America. Caprifoliaceæ to Compositæ.

At 77.—The Elements of Botany for beginners and for Schools. —*Charles E. Bessey.*

—A statement by me in the December *Naturalist*, relative to Mr. Harger's participation in the authorship of the volume on the Dinocerata, it has been claimed was unjust. Injustice to no one was intended, nor was there any personal feeling in the matter. My sole desire was to make it known, as no one else could, that a very large portion of Mr. Harger's scientific labors for the past seventeen years has been quite unknown to the scientific world. This is conceded by those most interested in the matter, and any details as to the precise part of the work that he committed to paper is immaterial. Professor Marsh insists that a portion of the descriptive matter of the Dinocerata was written by himself, and presents evidence which I will admit sustains his assertion. The chapters on the brain and skull I have in my notice of Mr. Harger conceded to him without in any way affecting the general fact. He must and will admit that a considerable part of the work was prepared by Mr. Harger without his name appearing anywhere as its author. I have nothing to say as to whether such a course was right or wrong. Others, with Professor Marsh, may claim that an author has a right to hire and pay for scientific work, without its being any one else's affair. I do say, however, without fear of denial, that much of the valuable scientific work published by Professor Marsh has been due to the conscientious accuracy, sound judgment, and general scientific scholarship of Mr. Harger. *The bibliography* was almost wholly prepared by myself, but was so modified that I should be loth to have its authorship imputed to me.—*S. W. Williston, Yale College, New Haven.*

—The Committee on the Marine Biological Laboratory have issued an appeal for aid in establishing the laboratory, from which we learn that $8,000 of the desired $15,000 have already been secured, and that it is proposed to start work before the full endowment has been secured. It is hoped—first, to secure a location at Woods Holl, Mass., where the fauna and flora are abundant and varied; second, to build a laboratory with two stories—the lower story to have accommodations for teaching at least twenty-five persons, the upper story to have work-places for investigators—to furnish aquaria, microscopes, microtomes, glassware, etc., also a constant supply of water for aquaria; third, to have a convenient landing, boats, collecting apparatus, etc. To meet the running expenses, fees will be charged those who work at the laboratory. The laboratory is to have two principal objects—first, the education of competent teachers of biology; second, the furnishing of suitable facilities for original investigation, such as are afforded students in Europe.

—The Boston Society of Natural History is agitating the establishment of an aquarium and zoological garden.

—Mr. Andrew Garrett, who has done so much to explore the molluscan fauna of the South Sea Islands, died in the Society Islands Nov. 1, 1887.

—George Robert Waterhouse, of the British Museum, died in Putney January 21, 1888. His later years were devoted to geology, but some years ago he published a commencement of a monograph of the Mammalia, a very useful work, which deserved completion.

—Dr. Max Schmidt died in Berlin February 3, 1888, in hi fifty-fourth year. He was formerly Director of the Zoological Garden in Frankfurt-on-the-Maine, but in 1884 was called to a similar position in Berlin, as successor to Dr. Bodinus.

—Dr. D. S. Jordan sails in June for Europe. It is his intention to proceed to Greece to study the fish-fauna of the Eastern Mediterranean.

—Professors O. P. Jenkins and B. W. Evermann have just received the collections which they made during last summer at Guaymas, on the Gulf of California. They are especially rich in fishes, some twelve species being new.

—August Friedrich, Count Marschall, the author of the Nomenclator Zoologicus (published in 1873), died in Vienna October 11, 1887.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Biological Society of Washington.—February 11, 1888.—The following communications were read:—Dr. Theo. Gill, "Character of the Family *Elacatidæ*;" Mr. Robt. T. Hill, "The Variations of *Exogyra ponderosa* Say;" "The Variations of *Gryphæa pitcheri* Morton;" Prof. C. V. Riley, "The Insectivorous Habits of the English Sparrow;" Dr. C. Hart Merriam, "A New Fox from California."

February 25, 1888.—The following communications were read: Mr. F. W. True, "Changes in the Catalogues of North American Mammals since 1879;" Dr. T. H. Bean, "Distribution and Some Characters of our Salmonidæ;" Dr. Cooper Curtice, "Some Early Stages in the Life History of *Tænia pectinata*."

March 10, 1888.—The following communications were read:—Mr. F. W. True, "Changes in the Catalogue of North American Mammals since 1877," Part II.; Dr. Geo. Vasey, "Foreign Trees and Shrubs Cultivated in the District of Columbia;" Dr. Theo. Gill, "The Classification of Cottoidean Fishes;" Dr. C. Hart Merriam, "Description of a New Species of American Skunk;" Mr. Robt. T. Hill, "The Southwestern Termination of the Atlantic Timber Belt."

March 24th.—Dr. Cooper Curtice spoke of "*Tænia fimbriata*, a New Parasite of Sheep;" Mr. Charles Hallock, "Reversion of Domesticated Animals to a Wild State;" Capt. J. W. Collins, "The Work of the Schooner Grampus in Fish Culture."

Appalachian Mountain Club.—Boston, January 3, 1888.—Prof. David P. Todd, of Amherst College, gave a paper describing his ascent of Friji-San, Japan, in connection with the recent eclipse expedition. The lecture was illustrated with stereopticon views.

January 10, 1887.—Annual meeting. The report of the secretary showed a total membership of 788, a gain of 15 during the year. In 1887 there were held nine regular, six special, and one field meeting. There were besides ten excursions. The following board of officers were elected: President, Augustus E. Scott; vice-president, Rest F. Curtis; recording secretary, Roswell B. Lawrence; corresponding secretary, Frank W. Freeborn; treasurer, John E. Alden; councillors—Natural history, George Dimmock; topography, George H. Barton; art, John Ritchie, Jr.; exploration, Frank O. Carpenter; improvements, Frederick D. Allen; trustee, for three years, Charles W. Kennard. After the result had been announced, Miss L. S. Davis gave an account of the dedication of the monument to De Saussure, and Mr. L. L. Hubbard made a few remarks concerning the convention at Villach, which he attended as delegate of the club. On Saturday, January 14, the club visited Pasture Hill, and on the 21st an excursion was made to Mt. Benedict.

Society of Arts.—Boston, January 10, 1888.—Prof. W. T. Sedgwick read a paper entitled "A Biological Examination of the Water Supply of Newton, Massachusetts," it being a record of joint work done on the subject by the speaker and Mr. S. R. Bartlett. A description was first given of the filter basin near the Charles River, from which the Newton supply is taken. A striking difference was found to exist between the river and basin water. Water from the river gave as an average 261 colonies of Bacteria in a cubic centimetre; that from the basin, 42; from the reservoir, when the water is pumped, 23; and that taken from the tap in Newton, only 6. The following results bear out the opinion that Newton's water supply is superior. Newton water was thus found to contain 6 micro-organisms in a cubic centimetre; Spot pond, Malden, 10; Cochituate, 43; Mystic, 204; Croton, N. Y., from 54 to 256. The chemical tests also justified the reputation of the Newton water for purity.

The next paper, also read by Prof. Sedgwick, explained a "New Method for the Biological Examination of Air," by Prof. Sedgwick and Mr. G. R. Tucker. A description of the previous methods used for this purpose was first given. In the new method the air is drawn through a small tube containing granulated sugar, the sugar being then mixed in an enlargement of the same tube, with a proper amount of gelatine to insure the growth of any germs held by it. The apparatus for drawing always the same amount of air through the tube is an ingenious one, and is the invention of Mr. Tucker. It has been found by numerous experiments that the sugar catches all the Bacteria of the air. The apparatus is simple in construction and working, and is designed to be used in hospital wards and at any place where frequent examinations of the air are desired. It was shown in working order, and a large number of plates and tubes showing micro-organisms in various stages of development were exhibited.

American Philosophical Society.—May 20, 1887.—A paper from Prof. S. S. Stevenson, entitled "Notes on the Surface Geology of Southwest Virginia," was presented.

September 2, 1887.—The following communications were read: On "Biela's Comet and the Large Meteors of November 27–30," by Prof. Dan. Kirkwood, Bloomington, Ind.; On the "Systematic Position of the Mallophaga," by Prof. A. S. Packard, Providence, R. I. "Preliminary Report of the Vertebrate Fossils of the Uinta Formation, collected by the Princeton expedition of 1886," by Profs. W. B. Scott and Henry T. Osborn, Princeton, N. J.; Dr. D. G. Brinton read a paper entitled "Were the Toltecs an Historic Nationalty."

September 16, 1887.—A paper by Dr. A. C. Stokes, of Trenton, N. J., on some "New Fresh-Water Infusoria was presented."

October 7, 1887.—Prof. Cope presented a communication for the proceedings entitled the "Classification and Phylogeny of the Artiodactyla." Two communications from Mr. S. Garman, of Cambridge, Mass., entitled "Reptiles and Batrachians of Grand Cayman," and "West Indian Reptiles in the Museum of Comparative Zoology, Cambridge, Mass.," were read.

October 21, 1887.—Mr. P. C. Garrett read an obituary notice of Pliny-Earle Chase, LL. D., a vice-president of the Society. A paper on "Octonary Numeration and its Application to a System of Weights and Measures," by A. B. Taylor, was presented. Prof. Cope read a paper on the "Phylogeny and Classification of the Artiodactyla. Dr. J. Cheston Morris spoke of the remarkable resemblance between Devonshire sheep and goats, both ewes and bucks had horns and, like the goat, they had more than one period of reproduction in a year. Dr. D. G. Brinton, H. Phillips, Jr., and M. B. Snyder, were appointed a committee to consider the value of *Volapük.*

November 4, 1887.—Dr. Brinton read a paper on the so-called *Alaguilac* language of Guatemala.

November 18, 1887.—A paper entitled "Notes on the Ethnology of British Columbia," by Dr. F. Boas, was presented through the Secretaries. Dr. Brinton read an account of "An Ancient Human Footprint from Nicaragua," and in the discussion that ensued Prof. Heilprin stated that in his belief the deposit in which it occurred was Post-pliocene. Prof. E. J. Houston read a communication on a non-magnetizable watch invented by M. C. A. Palliard, of Geneva, Switzerland; and on the Gramophone, an invention of Edwin Berliner, of Washington, D. C. Prof. E. F. Smith presented a paper on "Electrolysis of Lead Solutions."

December 2, 1887.—Prof. D. Kirkwood, of Bloomington, Ind., presented a communication on "The Possible Existence of Fireballs and Meteorites in the Stream of Bielids."

January 6, 1888.—The committee of *Volapük* presented a supplementary report. Prof. P. H. Uhler, of Baltimore, read a paper on "The Albirupian Formation and its Nearest Relatives in Maryland." Profs. Lewis and Heilprin, in the discussion which followed, differed from Prof. Uhler in their views of the age of this formation, Prof. Lewis considering it as Silurian, Prof. Heilprin as Palæozoic and not Mesozoic.

Western Society of Naturalists.—A Western Society of Naturalists, embracing members from Ohio, Michigan, Indiana, Illinois, Wisconsin, Minnesota, Iowa and Missouri, was organized at Indianapolis, Dec. 29th, 1887. Its scope is like that of the American Society of Naturalists, the constitutions of the two being almost identical. The following officers were elected:—President, Profes-

sor S. A. Forbes, of Champaign, Ill.; Vice-Presidents, Professor W. J. Beal, of Agricultural College, Mich., Pres. T. C. Chamberlain, of Madison, Wis., and Professor Henry L. Osborn, of Hamline, Minn.; Secretary, Dr. J. S. Kingsley, of Bloomington, Ind.; Treasurer, Dr. John M. Coulter, of Crawfordsville, Ind. It was voted to hold the annual meetings of the Society in October, the first one to be held at Champaign, Ill. The first meeting was for organization and had no regular programme. Various members discussed methods of biological investigation and instruction. Dr. S. A. Forbes exhibited a number of pieces of microscopical apparatus in use in the Illinois State University and especially adapted for drawing microscopic objects.

Boston Society of Natural History, December 21, 1887.—The meeting was devoted exclusively to the Antiquity of Man in America. Professor F. W. Putnam exhibited a series of palæolithic implements found in the gravels at Trenton, New Jersey, by Dr. Abbott; in the gravel of the Little Miami Valley, Ohio, by Dr. Metz, and in the glacial deposit at Little Falls, Minnesota, by Miss Babbitt; also, for comparison, several from the gravel of the Valley of the Somme. Dr. Charles C. Abbott gave an account of the recent discoveries in the Trenton gravels and their bearing on the antiquity of man in North America. Professor G. F. Wright spoke upon the age of the Ohio gravel-beds in which the implements were found by Dr. Metz. Mr. Warren Upham read a paper upon the recession of the ice sheet in Minnesota in its relation to the gravel deposits overlying the quartz implements found by Miss Babbitt at Little Falls, Minnesota.

A discussion upon the Antiquity of man in the eastern and central portions of America followed the reading of the papers.

January 4, 1888.—Professor W. O. Crosby discussed the Geology of the outer islands of Boston Harbor. Mr. James H. Emerton described the Anatomy of the Chrysalis of the Milk Weed Butterfly.

February 1, 1888.—Mr. E. O. Jordan, of the Institute of Technology, read a paper on the beginnings of natural history in America.

February 15, 1888.—Dr. Geo. L. Goodale read a sketch of the life and work of the late Dr. Asa Gray.

March 7, 1888.—Professor W. O. Crosby read a paper on the geology of the Black Hills of Dakota.

March 21, 1887.—Professor F. W. Putnam described the great serpent-mound in Ohio, and Dr. J. W. Fewkes discussed the origin of the present form of the Bermudas, both papers being illustrated by the stereopticon.

Essex Institute, March 19, 1888.—Professor F. W. Putnam

spoke of the serpent-mound in Adams county, Ohio, which has recently come into possession of the Peabody Museum of American Archæology and Ethnology, at Cambridge, Mass. This mound was first brought to general knowledge by Messrs. Squire and Davis in 1849, previous to which time it had only a local reputation. It was then covered with forests, and has since been ploughed over a number of times and devoted to crops. The mound is lowest at the tail and increases in height toward the head, and varies from four to nine feet; in width it varies from eleven to twenty-one feet, and its length is about fifteen hundred feet. The serpent makes four or five convolutions, running north and south, and the tail ends in a triple coil. In front of the mouth is an oval mound, as though the serpent were about to swallow an egg—as the lecturer expressed it. On each side of the neck are two other mounds—one natural, growing out of the decay of an enormous oak tree, and the other artificial. Near the tail is another mound, built up from the white clay bottom, over which is a heavy layer of stones—not the limestone of the surface, but a sandstone brought from a creek a quarter of a mile away. In this mound, at a depth of from two to five feet, occur a considerable number of intrusive burials; but in the centre, lying at length on four inches of wood-ashes, was found the skeleton of a chief six feet in height, with a brain capacity greater than that of Daniel Webster. The speaker believed the mound to have been built in honor of this chief. The skeleton is in good condition, and is now preserved in the Museum at Cambridge. No weapon was found in the mound and no ornament, except one fresh-water clam-shell.

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SIX WEEKS IN SOUTHERN MINDANAO.

BY J. B. STEERE.

A THREE days' voyage from Puer to Princesa, in the island of Paraqua, by way of Balabac and Sooloo, brought us to the port of Zamboanga, in the southwest part of Mindanao. The harbor is of but little value. It is partly sheltered on the south by the low island of Santa Cruz opposite, but is open to the storms from the southeast. There had been a heavy blow from this direction before we arrived, and a high sea was running; but toward night we got our baggage into a huge dug-out, and were paddled ashore. After some trouble with the customs' officers over our baggage, we were finally, after dark, domiciled in a shaky old fonda, the only hotel the place affords, a liquor and tobacco shop and place for the sale of postage stamps and lottery tickets below, and a lodging place above. We got a promising view the next morning from our window into a yard below, where a dozen pairs of immense bivalve shells (*Tridacna gigas*) lay in the sun. A careful measurement of the largest pair showed three feet and five inches in length and two feet and five inches across the valves. They must have weighed toward two hundred pounds each, or four hundred pounds for a single shell. We found a single valve made a good load for two men. The Spanish naval officers, who seem, like other sea-faring people, to be given to telling large yarns, tell of one off the south coast of Mindanao which has long been noted for its great size, and that the officers of the steam frigate Salamanca once planned to take it home as a present to

Queen Isabella. They steamed down the coast until they found the shell, dropped their strongest hawser around it and put on all steam, but after some time found that instead of raising the shell the steamer was gradually sinking, being drawn under by the immense weight. So they cut the hawser and left the shell in its bed, where they declare it may yet be seen. The smaller species are found in the mud at low tide. Their toothed valves lie gaping apart, and must be traps ready set for any inquisitive monkey who may pass their way. The larger ones are found in deeper water, and there are stories of divers after pearl oysters being caught in their immense jaws and held to their death.

Zamboanga is a town of six or eight thousand inhabitants, nearly all Indian, but of mixed tribes, it having been a convict colony a generation ago, formed from the various islands of the group. The Spanish residents, twenty-five or thirty in number, are gathered with the principal Chinese merchants, at the south end of the town, near the old stone fort and the church. The native town reaches down the coast to the north for a mile and a half, but is concealed in an immense grove of the finest coco palms. The houses are of the ordinary Philippine type, — great baskets of nipa palm leaves, mounted on poles, eight or ten feet above ground. In front of a part of the native town is a village of Moros, Mohammedan natives, who may be the original inhabitants of the place. Their houses are of the same form as those of the Christians, but are poorer, and many of them built over the water, in true Malay style. These people seem to pretty nearly monopolize the business of boat-making and fishing for the town, leaving the Christians to cultivate the soil.

Behind the city is a level country extending for three or four miles to the foot of the hills. Much of it is overflowed and planted to rice. The hills themselves showed patches of sugar cane and other crops, whose cultivation was crawling up their sides, but above and beyond all was still unbroken forest.

We made daily visits to the market, and found the Moro men, marked by their red turbans and tight-fitting drawers, busy selling fish, while their wives were squatted on the ground with little piles — one for a cent — of shell fish spread out before them. Among these were several species of spider shells in abundance, some fine cones and cowries, and great numbers of several species

of bivalves; among them tree oysters, with fresh pieces of mangrove bark sticking to the valves, where they had chopped them loose with their knives.

The woods being too far away to make general collecting easy from the city, after two or three days' stay we embarked in a native outrigger boat, and after three hours of voyage were landed on the grand beach of Ayala, a little town fifteen miles from Zamboango to the north, where I had collected twelve years before. There being no house fitted for our use, we occupied with the officials of the place the tribunal, a large building near the church, and serving for jail, court-house, town-house, and lodging-place for strangers. Coming up to the back side of the town and tribunal were the level rice fields, now flooded with water and just planted or being planted to rice. The woods had been cut back a good deal in the last few years, but we found the rice fields swarming with water birds, and concluded to stop for some weeks. The first trip to the fields produced eight or ten species of waders, and many more followed; sandpipes, snipes, plovers, rails and herons, all in great variety. Many of them were no doubt migrants from the northwest, but several were breeding, and no doubt residents. The population of the place seemed to be hunters by instinct, and as soon as they found that they could get grandes (the big old Spanish copper cents which makes the small change of the islands) for living things, we were besieged by an array of helpers, big and little. Morning, noon and night they were at our door, with shells, turtles, snakes, lizards, birds, and everything else they thought might tempt the coppers out of our pockets. The boys set snares for the birds about the flowers of the trees, and scoured the woods and fields with their bamboo blow guns, and brought in sun birds, forest thrushes, orioles, tailor birds, cuckoos, and even a number of small owls caught napping in the groves of second growth. Several old contraband guns were brought out, and with powder and shot advanced by us, some of the older hunters brought from the woods, back loads of great hornbills, forest pigeons and jungle fowl, with now and then a big-footed mound-builder bird. One little old man, skilled in woodcraft, set a large number of lassoes on the ground, and made us daily visits with his game. The most abundant ground inhabiting mammal seemed to be a large spotted civet cat. One day he brought three of these, and

then a black long-tailed animal as large as a cat, and of the weasel family. After these he brought us jungle fowl, colored like Spanish game fowls, and a few of the large ground pigeons, with a bloody spot in the white breast, called by the Spanish pemhalada, stabbed with a knife. Whenever we could find time from our work of preparing the material purchased we made visits to the forest, and added many species not found by the native hunters.

Two hollow trees inhabited by Galeopithecus were found and chopped down, and from one of these eight were captured and there were others which escaped. They were old females, and young in all stages of growth, so that they would appear to breed the year round. We kept several of them living for some time, and had a chance to observe their habits. One specimen of the curious little Tarsius was brought in. It is probably not rare here, but from its nocturnal habits not readily found. The common monkey, Cynomolgus, was very abundant and tame. We got two species of squirrel, the little *Sciurus philippinensis*, of a dark brown color, not larger than a mouse, but a true tree squirrel, with large bushy tail. Besides this we found a larger red brown one, which does not seem to be described. Besides those mammals mentioned we got a rat and a large shrew, making nine besides the bats. Deer and wild pigs were plenty, but we got none during our stay. Two crocodiles six and a half feet long but apparently adult, were brought in living, tied hand and foot, and were tied to a post in the open space beneath the tribunal. A large monitor, different in species from the Paraqua ones, was abundant, as was also a plant-eating lizard, of about the same size, four or five feet in length, and called by the natives ibit. It is called good food, like the plant-eating iguanos of South America.

Among the lizards was a flying one, *Draco*, abundant on the coco trees, and differing in size and color from those observed in Paraqua. On opening the wing membranes one could not help noticing a likeness to a butterfly, both in shape of wings and in the coloring of nulattix blue with red spots. This case of resemblance must be added to the long list of cases of protective coloring. This peculiar coloring may aid the lizard both in escaping its enemies, the hawks, and in capturing its own food of insects. One evening one of our hunters came dragging in a python over twelve feet long and as thick as a man's arm, which he

had met and shot in the path, and three snakes were brought in of several species, some of them venomous. Among birds we procured three species of horn-fills, all different from those of Paraqua. Among them the great double-crested one, over a yard in length. These were found feeding in the wild fig trees at a height of one hundred and fifty to two hundred feet from the ground, and it tried all the shooting qualities of our guns to bring them down. They made the woods ring with their harsh cries of ca-la-o, from whence they got their native name. We found seven species of kingfishers, among them one apparently unnamed, and the rare spotted *hombroni*. We also found the species of broad-bill Eurylaimus, supposed to be confined to Basilan. It inhabits different heights in the two islands, and a more extended search may prove that the fauna of the two islands does not differ as much as has been supposed. Hawks were abundant and varied, and we procured some nine or ten species varying in size from the great sea eagle, closely allied to our bald headed eagle, and a fish hawk equalling it in size, to the little black hawk with white breast, Microhierax. It is about six inches in length, and one of the smallest of its tribe. The rice fields and adjacent swamps produced six species of rails and eight of herons, with a multitude of other waders.

After three weeks of hard work, interrupted by a few days of fever with two of the party, we returned to Zamboanga with a collection of seven hundred specimens of birds, of some one hundred and fifty species, fifty mammals, seventy-five reptiles, and a few fish and amphibians.

After a visit to the island of Basilan we returned to Zamboanga and went north again, this time to a little bay called El Recodo, or La Culdera, about twelve miles from the city. We had heard that corals were abundant here, and were not disappointed. A gap between the hills into which the sea entered, and then a long, low sand bar running out from one side and bending around, formed a quiet little bay, with deep water in the centre shoaling on every side. Two or three hundred Moros had built low, tumble-down houses along the inner side of the sand bar and over the water, while two or three Chinamen, who had followed them for purposes of trade, had built homes on the inner side of the bay on the Aquala road. After getting settled in one of these houses, we

took boats and paddled over to the bay. The water was very clear, and we could see plainly to a depth of twelve or fifteen feet. Most of the corals seem to grow above this depth, and most of the species here were within a few feet of the surface, and many of them exposed for some time at each tide. The quiet waters seemed to be especially fitted for the more delicate species of Madrepores, Pavonias and Stylasters. Many of these would break of their own weight on being taken from the water. Scattered among the stems of the branching forms were a large number of species of Fungias. Near the shore were whole reefs of most delicate Madrepores and millepores, which would break by dozens at each step as we waded over them, but the broken branches kept on growing, attached themselves to their neighbors, and the reef would be firmer than ever. As soon as the Moros found that we would pay for sea stones, they showed a greater desire for grandes than even the natives of Ayala had done, and there were soon a dozen boats over the bay coral fishing, while the women and girls were wading the reefs to find something that would suit our taste. In this way we got many species which would have escaped us. Even the chief of the village got out his boat, and diving down into about thirty feet of water, brought up specimens of a tree-like Oculina, with stems as thick as the wrist, and very heavy and jet black. He complained of a headache, but on being well paid tried it again next day. We bought and collected corals by the boat-load and spread them upon the sand point to dry and bleach in the sun until we had a ship-load, when we set to work to classify and select such as we could pack. We roughly estimated the species procured at this place at a hundred. Among the novelties was a curious little Fungia not larger than an old copper cent, but with the curious faculty of readily breaking into pieces, when each part would build itself into a disk again. Every storm would serve to multiply them. We found the packing a much greater job than collecting, but the villagers turned in and tore up cocoa-nut husks, and this, with rice chaff, furnished packing material of good quality. After two weeks of collecting, studying and packing we returned to Zamboanga and took the next steamer for the Central Philippines.

SYNOPSIS OF ROSENBUSCH'S NEW SCHEME FOR THE CLASSIFICATION OF MASSIVE ROCKS.

BY W. S. BAYLEY.

III. The Effusive Rocks.

THE effusive or volcanic rocks are those which flowed out upon a land surface and there solidified. For most of the intrusive rocks there are corresponding effusive ones, as might naturally be expected, but these latter are usually slightly more acid than the former.

The characteristic structure for this group is the porphyritic. The cooling of the effusive rocks takes place in two stages, (1) while the rock mass is still within the depths of the earth—the *intratellurial* period, and (2) after it has flowed out upon the surface—the *effusive* period. During the first stage certain minerals crystallize from the magma. These are idiomorphically developed, and become the porphyritic crystals in a ground mass which is produced by the cooling of the residual magma after it has reached the surface. As the cooling during the effusive period is comparatively rapid, there is a tendency for the ground mass of this group of rocks to approach the glassy condition. When, however, the cooling in the effusive period takes place slowly enough to allow of complete crystallization, a holocrystalline ground mass results and the rock assumes a *holocrystalline-porphyritic* structure.

When the cooling is rapid the ground mass is glassy, and the rock is said to have a *vitrophyric* structure. Between these two extremes are other rocks whose ground mass is composed partly of crystalline minerals and partly of glass. This is the *hypocrystalline-porphyritic* structure.

The ground mass of the holocrystalline-porphyritic rocks may be so developed as to possess either a hypidiomorphic-, a panidiomorphic- or an allotriomorphic-granular structure.

Since the structure of the older members of the effusive rocks

presents features which are different from those presented by the younger ones, it is convenient to separate them into an older and a younger group. The beginning of the Tertiary age seems naturally to be the line of division (in time) between the two groups.

III. A. The Palæovolcanic Effusive Rocks.

The palæovolcanic division of the effusive rocks is distinguished macroscopically by the lithoidal or stony character of the ground mass of its component members.

It includes a continuous series of rocks corresponding in mineralogical composition to the series composing the intrusive class, and, like this latter, is divided into families in accordance with the nature of the principal constituent minerals.

A. The Quartz-Porphyries.

The quartz porphyries are the old effusive equivalents of the granites. By far the larger portion corresponds in mineralogical composition to the granitites, so that no attempt has been made to subdivide them on mineralogical grounds.

They are porphyritically developed—quartz, orthoclase, biotite, sometimes hornblende and augite occurring in porphyritic crystals. The difference of structure observed in their ground mass affords the basis for their further subdivision.

1. Microgranite, in which the ground mass is a very fine panidiomorphic- or hypidiomorphic-granular combination of quartz and orthoclase.
2. Granophyre, in which the ground mass is holocrystalline, but is composed of quartz and orthoclase, developed in such a manner as to mutually penetrate each other.
3. Felsophyre, in which the ground mass is so very fine that its components cannot be recognized under the microscope. When carefully examined it appears as an almost isotropic substance with, however, some indications of structure.
4. Vitrophyre, in which the ground mass is a glass, with or without microlites and devitrification products.
    - (a) *pitchstone porphyry* contains porphyritic crystals, recognizable by the naked eye.
    - (b) *pitchstone* contains no macroscopic porphyritic crystals.

B. THE QUARTZLESS PORPHYRIES.

The quartzless porphyries are the old effusive equivalents of the syenites. They are porphyritically developed with an alkaline feldspar and one or more of the iron-bearing silicates as porphyritic crystals. Their ground mass is holocrystalline, consisting principally of feldspar and quartz. They are subdivided into:—

1. ORTHOPHYRE, containing a monoclinic alkaline feldspar among the porphyritic crystals.
   - (A) *biotite-orthophyre,* containing in addition porphyritic biotite.
   - (B) *amphibole-orthophyre,* with amphibole in porphyritic crystals.
   - (C) *augite-orthophyre,* with augite as the prominent porphyritic constituent.
2. RHOMBIC-PORPHYRY. This rock is characterized by the rhomboidal shape of its porphyritic feldspars, which belong to the anorthoclase series.
3. KERATOPHYRES, contains a sodium-rich alkaline feldspar, and sometimes quartz, porphyritically developed. Among the bisilicates a malacolitic augite is most prominent. The keratophyres include:—
   - (A) *keratophyre,* in which are no porphyritic quartzes.
   - (B) *quartz-keratophyre,* in which quartz is porphyritically developed.

C. THE PORPHYRITES.

The porphyrites correspond to the diorites of the intrusive class. They are characterized by the possession of plagioclase and hornblende, together with a dark mica or pyroxene, and sometimes quartz, as their principal components. They are porphyritic, but their ground mass may be either holocrystalline, felsitic or amorphous in character. They are divided in accordance with the nature of the predominating iron-bearing constituent, which occurs along with the plagioclase in porphyritic crystals, into:—

1. MICA-PORPHYRITES, containing biotite as their principal iron-bearing porphyritic constituent, including:—
   - (A) *mica-porphyrite,* which contains no quartz among its porphyritic components.

(B) *quartz-mica-porphyrite,* which contains quartz porphyritically developed.

2. HORNBLENDE-PORPHYRITES, containing hornblende as their most important iron-bearing porphyritic ingredient. According as these contain porphyritic quartz crystals or not, they are divided into:—
   (A) *hornblende-porphyrite,* quartz-free.
   (B) *quartz-hornblende-porphyrite,* quartz-bearing.
3. ENSTATITE-PORPHYRITES, containing a rhombic pyroxene as a prominent porphyritic component.

D. THE AUGITE-PORPHYRITES AND MELAPHYRES.

This class corresponds to the gabbros and diabases among the intrusive rocks. Its members consist essentially of plagioclase and augite, and sometimes olivine, idiomorphically developed in a ground mass which may be either holocrystalline, hypocrystalline or glassy. According as the members of this group are olivine-free or olivine-bearing they are divided into:—

1. AUGITE-PORPHYRITES, containing no olivine. This group embraces:—
   (A) *diabase-porphyrite,* possessing a panidiomorphic- or diabasic-granular groundmass of plagioclase and augite.
   (B) *spilite,* which is characterized by its fineness of grain and its lack of porphyritic constituents.
   (C) *augite-porphyrite,* having a fine-grained hypocrystalline ground mass in which are numerous porphyritic crystals of plagioclase and augite. Augite porphyrite includes:—
      (c 1) labradorite-porphyrite, in which the porphyritic feldspar is labradorite and the ground mass is composed of a second generation of augite and lath-shaped crystals of plagioclase and a very little glassy base.
      (c 2) weiselbergite, in which the ground mass is made up of a second and sometimes a third generation of augite and slender needles of plagioclase, arranged in flow lines in a glassy base (*hyalopilitic* structure).

(c 3) tholeiite, in which the constituents of the ground mass occur in but a single generation, and the structure is hypocrystalline through the existence of a little glass, which is aggregated in small areas between the crystalline components (*intersertal* structure).

(D) *augite-vitrophyrite*, consisting principally of a glassy ground mass in which are a few microlites of plagioclase, augite and magnetite.

1. MELAPHYRES, consisting essentially of plagioclase, augite and olivine. As in the augite porphyrite proper, three types are distinguished :—

(A) *navite*, an olivine-bearing rock corresponding in structure to labrador-porphyrite.

(B) *olivine-weiselbergite*, with the characteristics of weiselbergite.

(C) *olivine-tholeiite*, an olivine-bearing tholeiite.

E. THE PICRITE PORPHYRITES.

The picrite porphyrites correspond to the intrusive peridotites. They are composed of idiomorphic olivine and augite crystals in a ground mass, which consists principally of a glassy base, which by devitrification often becomes weakly doubly refracting.

The picrite-porphyrites are limited in their distribution. They are characterized particularly by the lack of feldspar in porphyritic crystals.

III. B. THE NEOVOLCANIC EFFUSIVE ROCKS.

The neovolcanic rocks occur principally as lavas, on the surface of the earth, as intercalated layers between sedimentaries, as dykes, volcanic necks and bosses. They are characterized by the vitreous appearance of the feldspars.

They are divided according to their mineralogical composition into families corresponding to those of the intrusive and palæovolcanic classes.

A. THE LIPARITES AND PANTELLERITES.

The liparites and pantellerites are composed essentially of an alkaline feldspar and quartz in porphyritic crystals, together with a ground mass which may be either holocrystalline or glassy.

They are separated according to the nature of their porphyritic feldspathic constituents into liparites and pantellerites.

1. Liparites, in which the porphyritic alkaline feldspar is sanidine. These are divided into:—
   (a) *nevadites*, containing numerous porphyritic crystals and a ground mass whose structure forms the basis for a further subdivision into:—
   (*a* 1) nevadite, with a holocrystalline ground mass.
   (*a* 2) felso-nevadite, with a felsitic ground mass.
   (*a* 3) hyalo-nevadite, with a glassy ground mass.
   (b) *liparites*, containing few porphyritic crystals, and these few almost exclusively sanidine. These include:—
   (*b* 1) liparite, with a holocrystalline ground mass.
   (*b* 2) felso-liparite, with a felsitic ground mass.
   (c) *hyalo-liparite*, a glass with the composition of liparite, containing microlitic inclusions of sanidine, quartz and the iron-bearing silicates.
2. Pantellerites, in which the porphyritic constituent is anorthoclase.

B. THE TRACHYTES AND QUARTZLESS PANTELLERITES.

This group is characterized by the predominance of an alkaline feldspar among its porphyritic constituents, and its freedom from quartz. In addition to the feldspar there is usually an iron-bearing mineral porphyritically developed.

Their structure, like that of the other effusive rocks, varies widely, but always tends to the porphyritic.

This group is divided into:—

1. Trachytes, in which the porphyritic component is sanidine. The trachytes are next subdivided into:—
   (a) *trachyte*, with a holocrystalline to hypocrystalline ground mass.
   (*a* 1) mica-trachyte, with sanidine and biotite as the most prominent porphyritic constituents.
   (*a* 2) augite-trachyte, in which augite replaces the biotite of (*a* 1).
   (b) *phonolitic trachytes*, differing from trachyte proper principally in the possession of the characteristic minerals of phonolite, viz., ægirine, acmite and sodalite. They include:—
   (*b* 1) sodalite-trachyte, which is rich in minerals of the sodalite group.

(*b* 2) acmite trachyte, in which the amphiboloids are acmite, ægerine and arfvedsonite.

(C) *andesitic trachytes*, with a hyalopilitic ground mass tending strongly to a glassy development.

(*c* 1) biotite-hypersthene-trachyte, containing biotite, hypersthene, augite and sanidine in a glassy ground mass.

(*c* 2) the Arso type, in which sanidine and augite are the principal porphyritic minerals, and the ground mass is hypocrystalline.

(D) *hyalo-trachyte*, consisting principally of glass, with the composition of trachyte.

2. QUARTZLESS PANTELLERITES, have anorthoclase and iron-bearing minerals as porphyritic constituents.

C. THE PHONOLITES.

The phonolites embrace the quartz-free combinations of an alkaline feldspar with the minerals of the nepheline and leucite groups, and usually a monoclinic augite.

They include:—

1. PHONOLITES PROPER, containing nepheline and feldspar as the essential porphyritic constituents, as well as the essential components of the ground mass, which is holocrystalline, hypocrystalline, or glassy.

(A) *trachyte-phonolite*, in which sanidine predominates over the nepheline, particularly in the ground mass.

(B) *nephelinite-phonolite*, in which nepheline predominates over the feldspar.

(C) *hyalo-phonolite* or *Phonolite Glass*, a glass with the composition of phonolite, containing microlites of sanidine and augite.

2. LEUCITE-PHONOLITES, containing leucite instead of nepheline among the porphyritic constituents.

3. LEUCITOPHYRES, containing both leucite and nepheline in addition to sanidine.

D. THE DACITES.

The dacites are quartz-bearing plagioclase rocks. They contain, also, one of the iron-bearing minerals of the biotite, amphibole or pyroxene groups.

Their structure varies widely in consequence of the fact that they occur at considerable depths within the earth, and are moreover very sensible to chemical alteration. They are separated, according to their structure, into:—

(A) *holocrystalline dacites*, with many or few porphyritic constituents.

(B) *felsodacites*, with a microfelsitic ground mass.

(C) *andesitic dacites*, with a hyalopilitic ground mass.

(D) *vitrophyric dacites*, or *dacite glasses*, with the composition of dacite holding porphyritic crystals of plagioclase, quartz and the iron-bearing silicates.

E. THE ANDESITES.

The andesites are neovolcanic rocks, composed principally of plagioclase and the iron-bearing silicates of the biotite, amphibole and pyroxene groups, thus corresponding to the porphyrites of the palæovolcanic group, and the diorites, and some of the gabbros of the intrusive class.

They are divided, according to the prevalence of one or the other of the iron-bearing silicates among the porphyritic constituents, into:—

1. MICA-ANDESITES, in which biotite predominates over the other iron-bearing minerals. They are subdivided, according to the structure of their ground mass, into:—

   (A) *holocrystalline mica-andesites.*

   (B) *felsodacitic mica-andesites.*

   (C) *mica-andesites proper.*

   (D) *trachytic mica-andesites.*

   (E) *vitrophyric mica-andesites.*

2. HORNBLENDE-ANDESITES, in which hornblende predominates. These are subdivided as are the mica andesites.

3. AUGITE-ANDESITES, in which a monocline augite is the prevailing iron-bearing porphyritic constituent. Subdivided like the mica-andesites.

4. HYPERSTHENE-ANDESITES, in which a rhombic instead of a monoclinic augite is the prevailing porphyritic constituent. Subdivided like the mica-andesites.

5. HYALOANDESITES, or ANDESITE GLASSES, glasses with the com-

position of andesite, containing a few microlites corresponding to the porphyritic components of the andesite group.

F. THE BASALTS.

The basalts are composed essentially of a plagioclase feldspar and augite, with or without olivine. They differ from the andesites in the predominance of augite over biotite and hornblende, and are thus the equivalents of the diabases.

They possess a wide range of structure, from the hypidiomorphic-granular to the glassy.

They are separated into two great divisions, distinguished by the presence or absence of olivine.

1. OLIVINE-FREE BASALTS, containing plagioclase and augite in a hypocrystalline ground mass.
2. OLIVINE BASALTS, in which olivine is an essential constituent, in addition to plagioclase and augite. Among the olivine basalts are included:—
   (A) *hypersthene basalt*, with an orthorhombic augite as one of the porphyritic constituents.
   (B) *quartz basalt*, with corroded quartzes among the augite, olivine and plagioclase of the first generation.
   (C) *hornblende basalt*, with brown hornblende as a porphyritic ingredient.
4. HYALOBASALTS, OR BASALT GLASSES, glasses with the composition of basalt, containing microlites of augite, plagioclase and olivine.

G. THE TEPHRITES AND BASANITES.

The tephrites and basanites contain as essential constituents a basic plagioclase and nepheline or leucite, or both. The former are olivine-free, the latter olivine-bearing.

They differ from the phonolites in the nature of their prevalent feldspar.

Their most common structure is the holocrystalline porphyritic

1. THE TEPHRITES are the olivine-free varieties. They are subdivided, like the phonolites, into:—
   (A) *nepheline-tephrite*, in which nepheline occurs generally as a constituent of the ground mass, but occasionally also in porphyritic crystals.

(B) *leucite-tephrite,* in which leucite replaces the nepheline of the tephrite.

(C) *leucite-nepheline-tephrite,* containing both nepheline and leucite.

2. BASANITES contain olivine as an essential constituent. The olivine is almost always present in porphyritic crystals.

   The basanites are subdivided, like the tephrites, into:—

   (A) *nepheline-basanites.*

   (B) *leucite-basanites.*

   (C) *leucite-nepheline-basanites.*

H. THE LEUCITE ROCKS.

The leucite rocks are unique, in that they occur only in the younger effusive series. They contain leucite instead of feldspar as their principal component. With this is always associated augite, and frequently biotite. The occurrence or non-occurrence of olivine serves as a means of separating them into two divisions:—

1. LEUCITITE contains no olivine. Its structure is panidiomorphic- to hypidiomorphic-granular, although it occasionally becomes porphyritic through the development of leucite and augite in two generations.
2. LEUCITE–BASALT contains olivine. Both olivine and augite usually occur in porphyritic crystals, leucite rarely or never. Their structure is porphyritic.

I. THE NEPHELINE ROCKS.

Like the group of the leucite rocks, the present group, which embraces rocks composed principally of nepheline and augite, has no equivalent among the intrusives or the palæovolcanic class.

The prevailing structure is the porphyritic with the iron-bearing silicates and olivine, when it is present, and sometimes nepheline as the porphyritic constituents, while the ground mass is hypocrystalline, and made up in large part of nepheline.

The nepheline rocks are separated into two divisions:—

1. NEPHELINITES, which contain no olivine. These are subdivided, according to structure, into:—

   (A) *doleritic nephelinites,* which are coarse hypidiomorphic granular varieties.

(B) *basaltic nephelinites*, usually porphyritic, with less nepheline and more augite than the doleritic varieties.

(C) *phenolitic nephelinites*, porphyritic varieties with nepheline in two generations and a light-colored augite (acmite) only in the ground mass.

(D) *camptonitic nephelinites*, porphyritic varieties with a base composed principally of nepheline or a glass with the composition of this mineral, and numerous porphyritic crystals of augite and hornblende, sometimes in two generations.

2. NEPHELINE–BASALTS, olivine-bearing. The prevailing types are those corresponding to the doleritic and basaltic nephelinites.

J. THE MELILITE ROCKS.

Melilite rocks are also confined to the neovolcanic class. They have no representatives among either of the other classes. They consist essentially of melilite, olivine and augite.

Their normal structure is the holocrystalline porphyritic, in which olivine, augite and biotite, and sometimes melilite, occur in two generations, although the last-named mineral is more commonly found only in the groundmass.

The separation of the group into two varieties:—

(A) *melilite-basalts*, and

(B) *alnöites*, rests almost entirely upon geological grounds. The alnöites, however, are much richer in augite than the melilite basalts, and also contain more biotite.

K. THE LIMBURGITES AND AUGITITES.

This group includes rocks composed in larger part of pyroxene, with or without olivine. They usually contain also a little plagioclase and hornblende.

Their normal structure is the hypocrystalline porphyritic, though sometimes they become completely amorphous through the absence of porphyritic constituents.

They are divided into:—

1. LIMBURGITES, which are olivine-bearing, and
2. AUGITITES, which are olivine-free.

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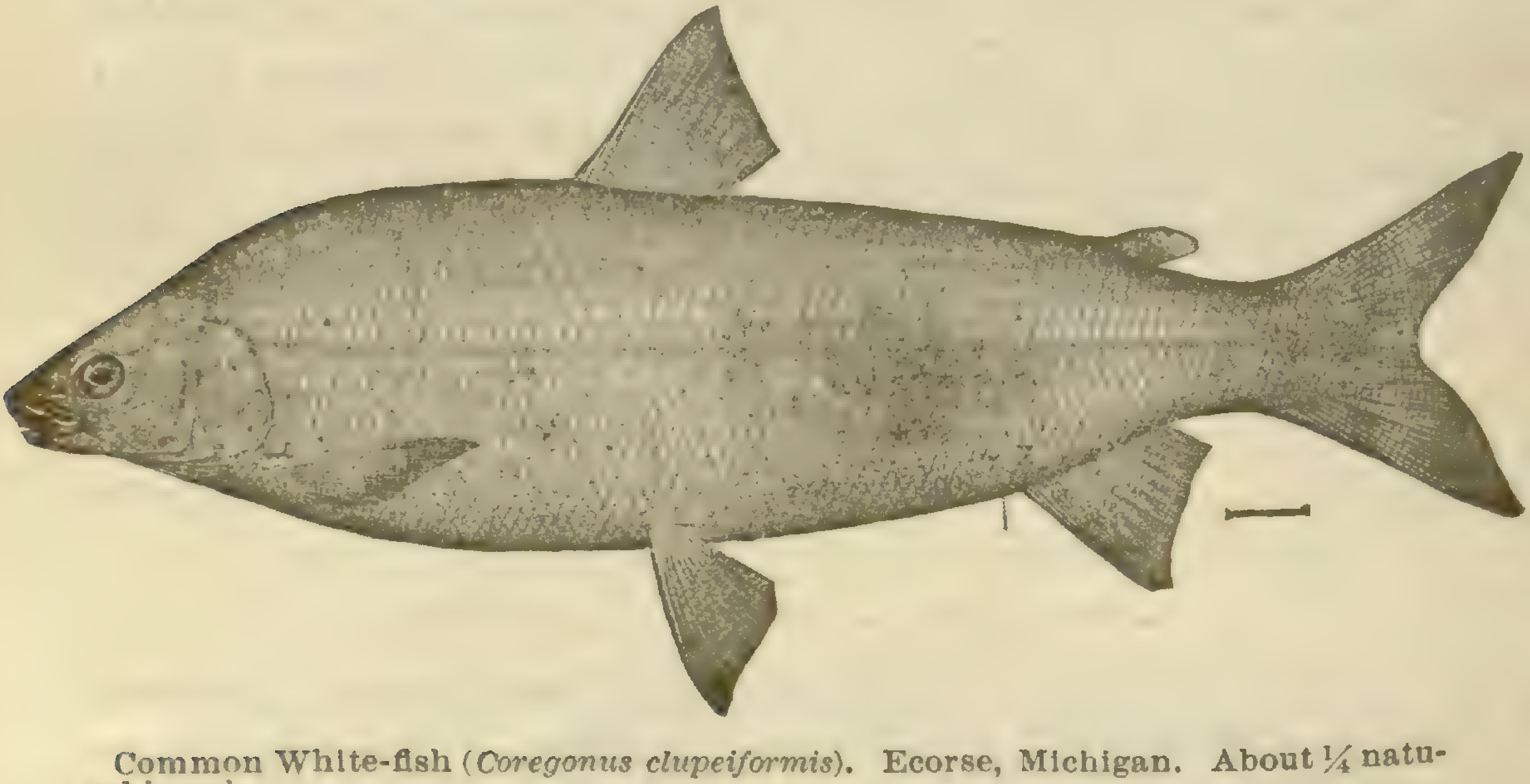
DISTRIBUTION AND SOME CHARACTERS OF THE SALMONIDÆ.[1]

BY TARLETON H. BEAN.

THE family of Salmonidæ—embracing the white fishes, the salmons, and the trouts—is one of the most important of the temperate and arctic regions of the world. For the purposes of this paper, I exclude all of Argentininæ, which have very little value, if we except the capelin, the eulachon, and the smelts. I omit, also, the graylings (Thymallus), which are set apart by Dr. Gill as representing a distinct family, Thymallidæ. The genera included in my essay are the following: Coregonus, Stenodus, Oncorhynchus, Salmo, and Salvelinus.

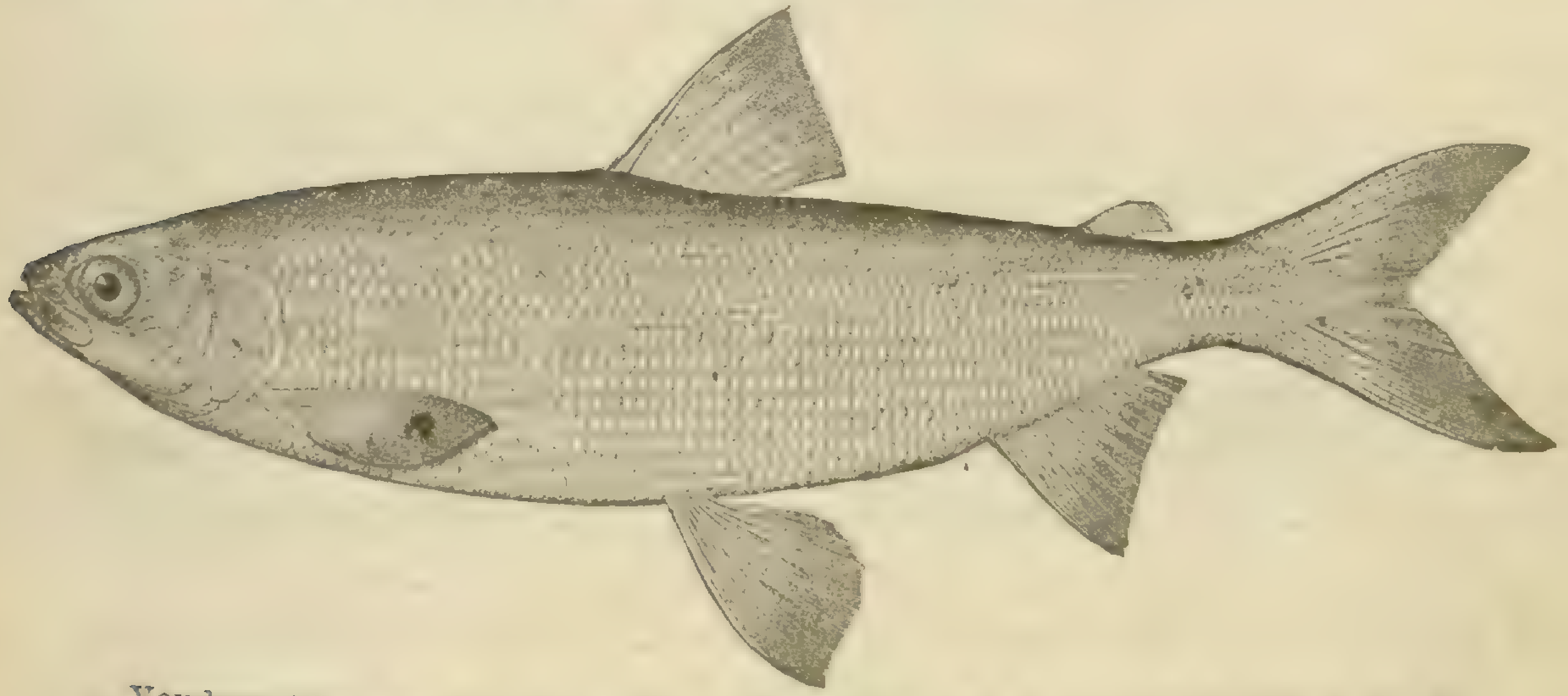


Common White-fish (*Coregonus clupeiformis*). Ecorse, Michigan. About ¼ natural length.

There are about forty nominal species of white fishes (Coregonus), of which twelve are North American, and are readily distinguished by good characters. Several species are found in Great Britain; the rest are distributed over the North of Europe and Asia, scarcely extending as far southward as 46° North latitude. The largest

[1] Read before the Biological Society of Washington, Feb. 25, 1888.

species exist in Russia, Siberia, Alaska, and our great lakes. The relation between the Siberian and Alaskan forms has never been fully worked out; but species which have been considered identical from the two sides of Behring Strait proved upon examination to be distinct. The species of Coregonus are anadromous only in the far North. One species, which is not represented in America—*Coregonus oxyrhynchus*—leads an existence which is indifferently marine or fresh-water. In the United States, the most southerly species—and one of the smallest, *Coregonus williamsoni*—is found as far south as the Sevier River, in Utah, in about 38° North latitude, or eight degrees farther south than any species in the Old World. Three species extend as far north as Point Barrow—laurettæ, nelsoni, and richardsoni, the first and the last of these being valuable food species. *Coregonus pusillus* probably reaches Point Barrow also, as I have seen it in Hotham Inlet.



Vendace (*Coregonus albula*). Baland Lake, Prussia. About ⅗ natural length. Introduced into the United States.

The most easterly of our white fishes are labradoricus, quadrilateralis, and artedi, all of which are small, and the last varies so much from the type to the eastward as to make its separation probable. The largest species are clupeiformis and richardsoni. Clupeiformis is the common white fish of the great lakes. It does not extend very far into British America, and is replaced northwestward in Alaska and the arctic portion of British America by the *Coregonus richardsoni* (kennicotti of late works).

Stenodus is believed to be nearly related to Coregonus; but its characters have not been fully studied. Its species reach a larger size than is usual in Coregonus. Only two are known with cer-

tainty, and these are closely similar. One of them is found in Alaska and the other in Russia. Other species are said to ascend some Siberian rivers from the Arctic Ocean. I have compared a specimen from the Volga with our Alaskan "inconnu," and find their similarity very striking. They agree substantially in number of fin-rays and rows of scales; but the first appears to have several more rows above the lateral line than the other.

Quinnat Salmon (*Oncorhynchus chouicha*). Columbia River, Oregon. About ⅛ natural length.

The genus of Pacific salmons (Oncorhynchus) which is very closely related to Salmo, is represented by five species, all of which are more or less black-spotted, especially while sojourning in streams. They ascend the rivers falling into the North Pacific in Asia and North America. The distribution in Asia is incompletely known. All of the species have been certainly identified from Kamschatka. *O. gorbuscha*, the little humpback salmon, extends farthest north, having been found in the Colville River in Alaska and ranging southward only to Oregon. The dog-salmon (*O. keta*) has been taken in the Kowak River, Alaska, and southward to California. The blue-back or red fish, *O. nerka*, extends northward at least to the Yukon and southward to the Columbia. Chouicha, the king or quinnat salmon, is known from the Ventura River, in California, to the Yukon, in Alaska. *O. kisutch*, the silver salmon, ranges from San Francisco, probably, to the Yukon. The most northerly species, gorbuscha, is the smallest and least valuable. The only good character which may be depended upon for distinguishing Oncorhynchus from Salmo is its numerous rays in the anal fin.

Salmo inhabits Great Britain and the Continent of Europe; it sends a representative into Africa; it is more or less represented in

Asia, and is well-established in North America. The Asiatic species are, for the most part, little known. Most of the species are non-migratory and inhabit fresh-water lakes and streams.

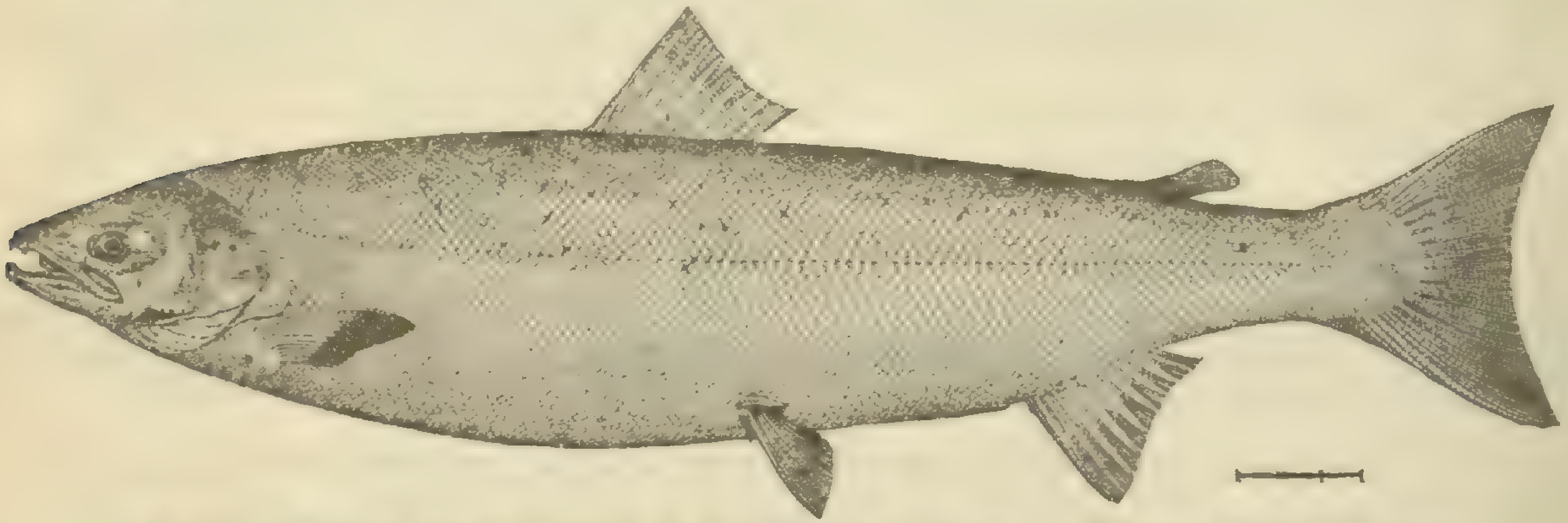
Blue-back Salmon (*Oncorhynchus nerka*). Wallowa Lake, Oregon. $\frac{1}{8}$ natural length. "Hook-jawed" male.

In the Eastern Continent, the southern limit of Salmo is in about 37° North latitude. A single doubtful species—*S. macrostigma* of Duméril, which may be identical with the common fario—was found abundant in the Oued-al-Abaïch, forty kilometres west of the town of Collo, in Northern Algeria. This species was founded on young specimens having about eight parr marks. The vomerines are figured as in two rows of about seven teeth each, just as in fario. The scales in British Museum examples are: 27, 122, 34; pyloric cæca, 28 to 31; vertebræ, 57. Their resemblance to young fario was observed by Dr. Günther.

Rainbow Trout (*Salmo irideus*). Verona, Missouri. About $\frac{3}{14}$ natural length. Introduced by U. S. Fish Commission.

In California one species, *Salmo irideus*, is found as far south as the Mexican line. But the most southerly of all our species and of

all the known Salmonoids of the world is mentioned by Professor E. D. Cope, in the AMERICAN NATURALIST, August, 1886, page 735. He has young black-spotted trout obtained by Professor Lupton from streams of the Sierra Madre, Mexico, at an elevation between eight and nine thousand feet, in the southern part of Chihuahua, near the boundaries of Durango and Cinaloa. They have teeth on the basihyals, and resemble, in other respects, *Salom purpuratus* of the Great Basin.



Atlantic Salmon (*Salmo salar*). Susquehanna River. About ⅛ natural length. Introduced by U. S. Fish Commission.

Students of the Salmonidæ in Europe frequently refer all of the numerous nominal species of Salmo to three principal forms—salar, trutta, and fario. The first two represent the genus Salmo, characterized by anadromous habits and imperfect development of the vomerine teeth. The third is placed in the sub-genus Fario, which has persistent, well-developed vomerines in one or two series, and, in its habits is non-migratory. One noticeable feature about the European species of Salmo is that they are nearly all large-scaled seldom having more than 125 scales in a longitudinal series. The only exception to this rule is *Salmo microlepis* of Hungary, which has 135 to 140 rows of scales. North America and Asia have at least one species of Salmo in common,—a small-scaled species,—*S. purpuratus*. This is the most widely-distributed and the most variable of our species. Northward, we have no certain knowledge of it beyond Unalaska; southward, it ranges to Mount Shasta, in California. Its distribution is extended by the varieties, henshawi, pleuriticus, and stomias. *Salmo henshawi* occurs in Tahoe Lake, California, Pyramid Lake, Nevada, and in streams of the Sierra Nevada. *Salmo pleuriticus* occupies the Utah Basin and the headwaters of the Rio Grande. The trout found in Mexico may be closely similar to this, as it seems to inhabit affluents of the Rio

Grande. *Salmo stomias* dwells in the Upper Missouri and in the Kansas River. It is the most easterly of all our black-spotted trout. *Salmo purpuratus* has hyoid teeth, and, in all its varieties, bears a crimson blotch on the under surface of the head, which is characteristic of the species. It has, also, small scales, which diminish progressively in henshawi, pleuriticus, and stomias.

Clark's Trout (*Salmo purpuratus*). Sitka, Alaska. About $\frac{3}{7}$ natural length.

The eastern limit of our species of Fario, as already stated, is reached by the *Salmo stomias*. East of the Mississippi Valley no species of this genus are found native. The distribution of the species of Fario would seem to indicate that they originated in Asia or the Continent of Europe and migrated both to the eastward and the westward. In America the eastward distribution was checked by the plains of the middle region, which do not furnish conditions favorable to salmon-life; and the ocean barrier on the east prevented the spread of Fario into our Atlantic streams. If these black-spotted species were better adapted for Arctic life, their range might have been similar to that of the red-spotted charr.

Before leaving the black-spotted salmonoids, it may be well to add something concerning the singular Huchen or Rothfisch of the Danube. The genus Hucho has very small scales, pyloric cæca very numerous, gill-rakers short and few, vertebræ sixty-eight, a forked caudal, a remarkably broad maxilla, with a well-developed supple mental bone, a pike-like skull, and peculiar dentition; the jaw are armed with strong teeth; the vomerines and palatines are strong and in a continuous series—the palatine portion very long; tongue with teeth; hyoid toothless. The range of the single known specie appears to be very restricted.

The genus Cristivomer, which appears to be only a section of Sal-

velinus, has two species, the lake-trout and the siscowet—namaycush and siscowet. The lake-trout is one of the largest and most widely

Lake Trout (*Salvelinus namaycush*). Raquette Lake, New York. About $\frac{3}{10}$ natural length.

diffused of the Salmonidæ. Richardson had it from Boothia Felix, in North latitude 70°. Turner found it very common in Labrador. It is very abundant in lakes of New England and New York and in the great lakes. We have obtained it recently from Henry Lake, in Idaho. This lake empties into Snake River, a tributary of the Columbia. We have also a head and fins of the species from Camin Lake, in British Columbia. Richardson records it from Great Bear Lake. Townsend and Stoney obtained specimens in the Kowak River, a stream flowing into Hotham Inlet, Alaska.

Dolly Varden Trout (*Salvelinus malma*). Cook's Inlet, Alaska. About $\frac{3}{10}$ natural length.

Eight species of Salvelinus are at present known in North America, only one of which, malma, we share with Asia. Seven of the species occur in eastern North America, and, with one or two exceptions, they are very closely related to the common saïbling of

Europe, *S. alpinus*. All of our species except fontinalis—the common brook trout—belong to the group having hyoid teeth. The largest species on both sides of our continent extend far to the northward: malma to the Colville River, in Alaska; stagnalis and rossi to Boothia Felix and Greenland. As a rule, all of our red-spotted charr with hyoid teeth have the dorsal and caudal fins without bands, while in the common brook trout—which is usually without hyoid teeth—these fins are always banded and mottled. The small charr of Monadnock Lake, in New Hampshire, *S. agassizi*, belongs to the group with hyoid teeth and forked tail. It has the dorsal and caudal banded, but the body has no mottlings, such as are found in fontinalis.

The character of the absence of hyoids in fontinalis is not to be absolutely depended upon in classification. About ten per cent. of the seventy-three examples obtained by Mr. L. M. Turner in Labrador have hyoids feebly developed, there being in no case more than three of these teeth present. From Castleton, New York, we have a specimen with hyoids; and in a brook trout from Woods Holl, Massachusetts, three hyoid teeth exist. It would seem that these, exceptional occurrences of hyoids are most pronounced and frequent in the northern portion of the habitat of fontinalis, the range of which species is now known to extend from Labrador to North Carolina, and, perhaps, Georgia.

Brook Trout (*Salvelinus fontinalis*). New York Market. ⅓ natural length.

The most northerly species of Salvelinus recorded is the arcturus of Günther, a species which is said to lack red spots. If the current illustrations be correct, this is the least highly-ornamented of the

genus. No specimens longer than twelve inches are known, and hese are mature. They were obtained in Victoria Lake, North latitude 82° 34′, and in fresh-water pools of Floeberg Beach (82° 28′). This species is the most northern salmonoid known.

Before leaving this subject it may not be amiss to recall the fact that the origin of the Salmonidæ is obscure. No fossils of true Salmonidæ are known, except one genus, which is based upon the cranial bones only. This genus, Rhabdofario of Cope, is from Lake Idaho, a late tertiary lake in Eastern Oregon and Western and Southern Idaho. The following account of the *Rhabdofario lacustris* is from Professor Cope's paper in *Proceedings American Philosophical Society*, 1870 :—

"A species with a head as large as that of the *Salmo salar*. The genus is nearly allied to Salmo. With no other portions of the animal than the cranial bones, the only difference I discover is in the form of the maxillary bones, which are sub-cylindric or rod-like, instead of flat or laminiform, as in Salmo. At the extremity, though flat, they are still narrow; and I do not find surface of attachment for the supernumerary bone of Salmo. Teeth on the maxillary and mandibular arches large, numerous; teeth on the vomer, glossohyal, and palatine bones also well developed. Muzzle and mandible subequal. Maxillary . . . . bearing reduced teeth near its extremity."

The pertinence of Rhabdofario to the Salmonidæ is, perhaps, open to doubt, on account of the shape of the maxilla and the probable absence of a supplemental bone.

OBSERVATIONS ON AMPHIUMA AND ITS YOUNG.

BY O. P. HAY, M.D.[1]

THE waters of our Southern States are inhabited by certain elongated air-breathing animals, which are popularly known and feared under the name of Congo Snakes; although they in reality belong not among the serpents, but to the class of Amphibians. Of these animals, naturalists have up to near the present time recognized two species, and even two distinct genera, Amphiuma and Muræнopsis, the two forms being distinguished by the possession respectively of two and three digits to each of their very feebly developed legs. The occasional finding of specimens with two toes on some of the feet, and three on the others, has cast doubt on the generic value of this character, and made it quite certain that both belong to the same genus.[2] As there are few or no other differences of importance between the two supposed species, it is now thought by some batrachologists that there is after all but a single species; and this is the view at present held, I believe, by Professor E. D. Cope, the best American authority on such matters.[3] *Amphiuma* (*Murænopsis*) *tridactylum* is, in this case, to be regarded as merely a variety of *A. means.*

Of the habits, especially the breeding habits, of the lower Amphibia, in species of which North America is rich beyond all other countries, little appears to have been discovered. Siren, Necturus, Amphiuma and Cryptobranchus are all strictly aquatic, or nearly so, in their manner of life. With a few remarkable exceptions, our Amphibia, whether affecting a terrestrial or an aquatic habit in adult life, lay their eggs in the water; and the young, for a time after hatching, live in that element, and breathe by means of gills. In cases where the young of a species have not been discovered, it has been assumed that they possess gills, which are afterward absorbed.

[1] Published by permission of Dr. John C. Branner, Director of the Arkansas Geological Survey.

[2] Ryder, Proc. Phil. Acad., 1879, p. 14.

[3] Proceedings Amer. Philosoph. Soc. 1886, p. 526.

This assumption has been made in the case of Amphiuma. On general principles, Cuvier concluded that in early life it has gills. This was uncertain, and has been denied. Later authorities, among them Professor Huxley, state that its gills are "caducous," but that this conclusion rests on any one's observations I am not aware. Of its other habits little seems to be known. Holbrook, in his great work on North American Reptiles, thus speaks of the species:—

"*Amphiuma means* lives in muddy water or in mud. Harlan says they have been found at Pensacola three feet or more deep in mud of the consistency of mortar, in which they burrow like earthworms. They inhabit the ditches of our rice-fields, and feed on small fish and various fresh-water shells, as Unio, etc.; beetles and other insects have also been found in their stomachs. Sometimes, like eels, they are found on dry land, but for what purpose they approach it is unknown" (N. A. Herp., 1842, v., 91).

"I am unacquainted with the habits of the *Amphiuma tridactylum*, but suppose these to be similar to those of the *Amphiuma means*" (Ibid., 93).

At the close of August, 1887, I spent a few days in Little Rock, Ark., in the employ of Dr. Branner, of the Arkansas Geological Survey. On September 1st I visited a cypress swamp in the vicinity of the city for the purpose of collecting some reptiles. During the severe summer drought this swamp had been almost completely dried up, and there was little chance to get anything except by turning over pieces of fallen timber. Beneath a log of considerable size I found, to my surprise, a large animal coiled up, which by its smooth glistening skin I immediately saw could not be a snake; but, having never before seen a living Amphiuma, it took me some time to realize that I had before me one of these animals. After making due preparations to prevent its escape, I gave the animal a push with a stout stick, and then, no attempt at retreat being made, I lifted it out of the slight depression in which it was lying and let it straighten itself out. Meanwhile I had observed, lying in the midst of the coils, a mass of moist-looking matter, nearly as large as one's fist. Picking this up, I discovered it to be a mass of eggs. This was put into a jar of alcohol, and immediately the young within the egg could be seen writhing about, thus showing that they were in an advanced stage of development. The mother offered no resistance on being handled, and was put into a

small school satchel and carried to the State Geologist's office, a mile away, with two empty fruit jars lying on her. That night she was kept in an empty boot-box. This was some eighteen inches in height, and from it she made efforts to escape. She would erect herself in one corner until her head was on a level with the edge of the box, but she could get no further. Once in falling down she uttered a shrill sound somewhat like a whistle or the peeping of a young chicken. A cry like that of a young duck has been attributed by some observer to the Siren, but Barton in some of his writings denies the statement that such a sound is made.

The limbs of these animals are very small. For instance, of this one, having a length of thirty-one inches, the hinder limbs are only three-fourths of an inch long, the anterior only one-half an inch. Yet, when it was moving over the ground or the floor, it was amusing to observe that its feet were put forward and drawn back, as if they really could be of some use.

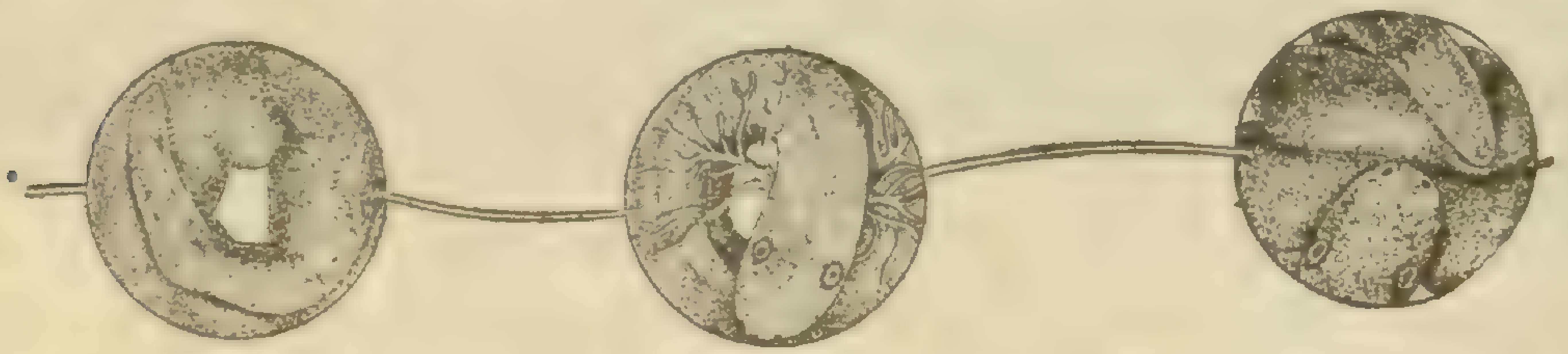
On irritating this Amphiume by pushing her with a stick she would snap at it viciously, and on further irritation would seize it in her jaws and, springing from the floor in the form of a spiral, would turn rapidly round and round, thus twisting the stick in one's hand. Any enemy thus attacked would certainly find his interest in the affair fully aroused.

There are two points in the structure of the adult to which I wish to call attention; although no doubt they have already been observed by anatomists. The first is that there is a little lobe of skin forming the anterior boundary of the gill-opening, and another forming the posterior border. These can be very closely applied to each other, and seem to form a very efficient valvular apparatus, by means of which this useless relic of its larval life may be closed up. The other structure is connected with the mouth. The lower lip is formed of a fold of skin that is separated from the skin of the throat by a deep groove that runs from the corner of the mouth to near the symphysis. This fold has a thin sharp edge, and is directed downward and outward. The upper lip also has a sharp edge which, when the mouth is closed, widely and closely overlaps the lower lip. This arrangement of the lips and that of the gill opening seems to me to have relation to the burrowing habits of these animals, and are designed to prevent the mouth and pharynx from being filled with mud.

The eggs of the Amphiume are the most remarkable that I know of as occurring among the Amphibians. The young, which now constitute the whole contents of the eggs, are surrounded by a transparent capsule about as thick as writing paper, and these capsules are connected by a slender cord of similar substance. It is as if the gelatinous mass surrounding the eggs of the toad should become condensed into a solid covering and a connecting cord. How many strings there are of these eggs I cannot determine with certainty, on account of their being inextricably intertwined; but, since there are four ends visible, there are probably two strings, one for each oviduct. For the same reason I have not been able to count the eggs. A careful estimate makes at fewest 150 of them.

The eggs, in their present state, are nearly globular, and average about 9 mm. in diameter. Their distance apart on the string varies from 5 to 12 mm.; fourteen of them were counted on a piece of the string nine inches long. At this rate the whole mass would form a string about eight feet long. The connecting cord varies from 1.5 mm. to one-half that diameter. The eggs greatly resemble a string of large beads.

The young are coiled within the capsules in a spiral form. On removing them and straightening them they measure about 45 mm.



in length. The color is dusky above, with indications of a darker dorsal stripe, and on each side a similar darker band. Below, the color is pale. The body is proportionally stouter than in the adult and the head broader. The fore and the hind feet have each three toes.

The young possess conspicuous gills; and, since they are evidently near the period of hatching, it is but fair to suppose that they would continue to retain these gills for some time after exclusion. The gills are three in number on each side, and are simply pinnate in form. The median gill is longest, measuring some 9 mm. in length. From its main axis there arise about ten delicate twigs. The other gills are somewhat shorter, and give origin to about eight lateral twigs each. In all these filaments may be seen the blood-

vessels filled with the large blood-corpuscles for which Amphiuma is noted. Three gill-slits are open, of which the two posterior become closed in the adult. The eyes appear to better advantage than later in life.

The finding of these young, nearly ready for active life, in such an unexpected situation suggests some interesting problems. At what period of their development are these eggs deposited? If at an early period, the mother must incubate them for a considerable time. If at a late period, why should they be placed in such a situation? In either case it appears to be quite probable that they are fertilized before they are deposited. Again, how are the eggs in such a dry situation saved from being thoroughly desiccated? They are, I think, kept moist by the body of the mother as she lies coiled around them. My remembrance of her as she lay when first exposed is that she was much plumper than she now appears in alcohol; and when she was laid down on the office floor every spot she touched was made wet. The source of this water I do not know; but it appears probable that it came from the numerous glands that fill the skin, and that the mother makes nocturnal visits to the water to lay in supplies.

Another question to be considered is this: What is to become of the young when they are hatched? How can these feeble little animals make their way to the water some rods away over ground that is covered with rubbish, dry, and full of cracks? How is it brought about that their delicate gills are not withered when exposed to the dry air? Is it possible that, like some species of snakes, the young crawl down the mother's throat while she carries them to the water? It has been suggested to me that just before hatching she may carry the eggs in her mouth to the water; but the whole mass could not be taken into the mouth, and she could only carry them as a dog carries a large bone. It is evident that we have several things yet to learn about the habits of Amphiuma.

By means of dissections and microscopical sections I have made some observations on the structure of the young of the Amphiuma as they were found in the eggs above described. A thorough study is being made of these embryos, and I hope soon to publish a paper giving details and drawings. I here note the most salient features of the skull and shoulder girdle.

As might be expected of the young Amphiume, hatched in a situation removed for some distance from the water in which it is to pass the greater part of its life, and to which it must with some difficulty find its way, its whole organization is in a far more advanced stage of development than is that of those Amphibia which are excluded directly into their yielding native element. A comparison of the skull of the young Amphiume with that of the larval axolotl, as described by Messrs. Parker and Bettany, shows that the former corresponds in many respects to the earlier phases of the fifth stage of the latter. The axolotl in this stage is 1¼ inch in length, but when hatched was only about one-third of an inch long (Morphology of the Skull, p. 107).

One of the most interesting features of the skull is the deficiency of cartilage in some regions. The otic capsule is well developed and large. Enclosed within it are the semicircular canals and a large otolith. The notochord runs well forward and is partially ensheathed with bone. The exoccipitals, also, are ossified down almost to the notochord, and the ossification extends into the condyles. On each side there is a narrow band of cartilage that rises up from the hinder end of the ear-capsule toward the middle line, but it lacks considerably of meeting its fellow. Nowhere does the cartilage extend to the middle line above the brain, and nowhere is the brain-cavity roofed over with bone. In the basilar region there is on each side of the notochord a large elliptical fenestra in the cartilage, so that there is only a narrow band lying along each side of the notochord, and a very narrow strip attached to each otic capsule. The trabeculæ are united around the extremity of the notochord, and send back on each side a process to the otic cartilages. These trabeculæ enclose a very large oval pituitary space. They are narrow and, meeting in front in the ethnoidal region, coalesce for a very short distance. There are very short decurved cornua and narrow bands that run outward beneath the nasal sacs. From each trabecula there is given off on the outside a band of cartilage that runs forward and outward, and near its termination sends outward a narrow strip of cartilage over the posterior end of the nasal sacs. This process I regard as the antorbital. There is what appears to be a small postpalatine and a small pterygoid cartilage that does not extend back to the suspensorium. The latter is broad and is directed forward. There is a stapes with the facial nerve passing

beneath it. Meckel's cartilage runs forward nearly to the symphysis. The hyoidean arch consists of a short hypohyal and a longer ceratohyal. The latter has along its inner side a narrow and easily separable splint of bone. The branchial apparatus is much as in the adult. The first arch is partially ossified. No other ossifications than those mentioned are found in the cartilaginous cranium.

There are several membrane bones. A large parasphenoid underlies the pituitary space and the basilar region. In front of this, in the roof of the mouth, are dentigerous vomers. The maxillaries are probably not represented by actual ossifications, but two rows of dental papillæ shows where they will appear. There is no palatine or pterygoid. The premaxillaries are present and completely consolidated. Their nasal spine is long and they bear prominent teeth. The side walls of the skull are protected by small frontals and larger parietals, but it is the frontal process alone of the parietal that is present. The suspensorium is partially covered by a squamosal.

The Meckelian cartilage appears to be ensheathed, as in the adult, by only two bones. One of these is the dentigerous dentary, which almost meets its platetrope at the symphysis. The other, lying along the inner side of the mandible, extends from the posterior extremity of Meckel's cartilage to a point two-thirds of the distance to the symphysis. It may be regarded as an angulo-splenial. It bears no teeth, as does the splenial frequently in the urodeles.

The shoulder girdle consists of scapular, coracoidal and precoracoidal portions, with no ossifications. These elements lack much of meeting in the middle line of the body below. There are a humerus, radius and ulna, carpals and phalanges. The humerus alone has a center of ossification.

The anterior vertebræ, at least, are ossified, the neural arches having coalesced with the sheath of bone surrounding the notochord. The upper portion of the neural arch is not yet ossified.

Only cursory observations have been made on the brain. As a whole it is far less elongated than in the adult. This shortening is due principally to the prosencephalic lobes, more than half of whose length lies alongside of the di- and metencephalon. Laterally, the epencephalic folds run so far forward as almost to touch the posterior extremity of the cerebral hemispheres.

EVOLUTION IN THE PLANT KINGDOM.[1]

BY JOHN M. COULTER.

PERHAPS I should apologize for selecting a subject that has anything to do with so hackneyed a theme as evolution; but you will discover that I intend neither to explain nor defend it. In this presence neither should be necessary. The purpose is to give an illustration of evolution from the plant kingdom, chiefly because illustrations of this law are commonly taken from the animal kingdom, and also because the case among plants is even more striking. One who staggers at the evolution of the horse can find among plants such interminable intergrading that fixity of species becomes a dream of the past, when they were arranged like puppets that popped up in their places when called for, always looked just alike, and were perfectly expressionless. Zoologists are fortunate in having as their stock-in-trade forms of life in which man is specially interested, both as an acquaintance and a kinsman. The public that listens with pricked-up ears and discusses endlessly concerning the evolution of birds, mammals and man, and thus brings a certain popularity to zoology, cares not a straw for the wonderful structures of Gymnosperms and Lycopods, although furnishing irresistible arguments in favor of a theory that has revolutionized scientific thought. One sort of compensation has been that botanists have been considered a sort of harmless folk, while zoologists are "infidel," or "progressive," apostles of darkness or of light, according to the standpoint of the speaker.

Botanical work has been no less effective and advanced in these latter days; but it lacks that possibility of spectacular display which would keep it in the mouth of the public. Monkeys and men the public wants to know about, but Pteridophytes and Phanerogams are decidedly prosy.

It will be found, however, upon a fair examination, that Botany

[1] Presidential Address before the Indiana Academy of Science, December 28, 1887.

and Zoology are so mutually dependent and helpful that one cannot advance without the other, and the thoughts of both upon such a great question as evolution are practically the same.

Turning aside, therefore, from the broad and much-travelled highway which leads from the Moners to Man, we will strike into a by-path, which extends from Protococcus to Phanerogam, and point out a few of its most salient features. Zoologists should be interested in noting how the same ideas have been worked out in the into great kingdoms, and all should remark the wonderful unity of purpose pervading the whole domain of life.

I shall make no attempt to outline a great scheme into which every plant, however formed, shall fitly fall. If I were younger or less acquainted with botany, I could do this; for a young botanist usually begins by attempting to remodel all existing schemes of classification, just as a young college graduate can put veteran statesmen to shame. Botanists have no family-tree arrangement for plants, and will not attempt the construction of one until they know more about the life-histories of the lower groups and more about structure in all the groups. As Dr. Farlow said, in his Vice-Presidential address before the last meeting of the American Association for the Advancement of Science: "On abstract grounds alone, I presume that few botanists would object to the statement that all plants have developed from simple ancestral forms which were nearly related to some of the lower animals. But when it comes to saying in anything like a definite way that certain existing forms have arisen from other lower existing forms or their immediate allies in some past epoch, and so on, until the lowest form is reached, botanists may well insist that imagination should not be allowed too large a scope in supplying missing links. It is precisely in this point that zoologists have an advantage over botanists. The palæontological record of lower animals is more complete than that of lower plants, so that where the zoologist might reasonably form an hypothesis the botanist must rely more on his imagination, until in the end he finds himself in the possession of a chain composed, to a considerable extent, of missing links. As it is, if we would consider the evolution of plants, not getting much light on the progress of the lower forms from palæontology, we are compelled to trust largely to plants as we now find them, and to ask what are the inferences we are permitted to draw from existing structures and conditions."

Not so very long ago it was thought that at least one fact in classification was impregnable, viz., that there were two great and very distinct groups of plants, called Phanerogams and Cryptogams. These two were set off against each other as antipodal groups, between which there was nothing in common. Unfortunately, the names given to these groups were simply an expression of the botanical knowledge of the time. "Apparent reproduction" and "hidden reproduction" may have correctly expressed the facts with respect to these two groups once; but they are very far from doing so now. The modern botanist, with his more complete appliances and methods, has begun to resolve the great nebulous mass of Cryptogams, and has discovered in it distinct systems and groups. The whole subject of Cryptogamic classification is, of necessity, quite inchoate. Certain groups and relationships have been distinctly defined; but among them and around them there float numerous hazy forms that refuse to be classified. Our knowledge is not sufficient to attempt the work with any degree of certainty, but certain broad principles have been struck out which will serve to guide.

It is known now that Phanerogams form but one of several correlative groups. The most useful scheme of classification at present makes the number seven. These seven primary groups must be considered merely as convenient pigeon-holes in which to distribute our facts.

It is not my purpose to go into the details of any supposed order of evolution of the plant kingdom, but to give some general thoughts concerning it and to trace through the development of a single structure. Generalization is always easier than details; for in it one is never embarrassed by the facts.

It seems probable that the plant kingdom must have begun in some such form as Protococcus, the common green slime found staining foundation stones, bark, etc. It surely represents the unit of structure and of function in the vegetable kingdom. We can conceive of no simpler plant-form than a single chlorophyll-bearing cell. Some of you will recall the fact that we have unicellular plants without chlorophyll, such as yeast and bacterial forms; as well as forms called plants that seem to be mostly naked protoplasm, such as slime moulds; but the former probably represent degraded forms, while the animal or plant character of the latter

remains in doubt. At any rate, they probably have a far greater complexity than was formerly supposed. We have thus come to consider protococcoid forms as our foundation-stones in rearing the structure of the plant kingdom. Through all the Thallophytes (representing the four lowest of our seven primary groups) there run two parallel lines, the typical or normal plants, containing chlorophyll; and the degraded plants, which are destitute of chlorophyll. This distinction is a very deep-seated one in the plant kingdom, for chlorophyll-bearing plants alone can do normal plant work, viz., the conversion of inorganic to organic material through the agency of chlorophyll and sunlight. Plants without chlorophyll must live as parasites or saphrophytes, a degraded habit which leads to degraded structure. The former in the first four groups, are called Algæ, the latter Fungi. The general opinion, brought out clearly in the address of Dr. Farlow, already referred to, is that Fungi are degraded representatives of Algæ—relatives in reduced circumstances, whose lazy habits of parasitism have entailed upon them degenerate bodies. Just what Fungi have descended from what Algæ it is perhaps impossible to say. The chances are that some of our important Fungi are degraded representatives of algal forms which no longer exist. Specific statement with regard to this relationship is little better than guessing; but the general proposition seems to be fairly well established. We have advanced, then, thus far: that of the two parallel lines, Algæ and Fungi, which run through the four lowest plant groups, the plant kingdom is to be considered as having advanced in the line of the Algæ, the chlorophyll-bearing line; while the Fungi are simply so many degraded forms, which lie strewn along this line of general progress, like drift wood stranded along the banks of a stream. For our purpose, then, the Fungi are to be dismissed, their probable origin having been sufficiently indicated. Starting, then, with protococcoid forms, advancing along the lines of Algæ, and into the chlorophyll-bearing members of the groups above, what notions of evolution can be obtained? Examining our present schemes of classification it will be discovered that chief stress is laid upon the methods of sexual reproduction. It is, as yet, the best thread upon which our facts can be strung, and it usually expresses so thoroughly the highest effort on the part of the plant, that as it advances from simplicity to

extreme complexity it seems but fair to consider it a good index of relative rank. I intend to give in merest outline the development of sexual reproduction, guarding such an attempt with the following statements:—

1. This is taken as but a single striking line of development, and must be understood to be accompanied by many other details in asexual reproduction and vegetative structure which bear it out but which we have no occasion to mention. Just as in describing the evolution of the horse the toes are seized upon as the one among other structures most striking and most simple of presentation.

2. There are hosts of side issues which represent departures greater or less from this general line of advance, and which cannot be taken into account in this general sketch. In general, they can be all explained by the law of adaptation.

3. Even the line I propose to follow can be but imperfectly presented; as there is not knowledge sufficient to make it as complete as we would like it, and not time enough to present it as complete as we know it.

Taking, therefore, this thread of sexual reproduction as a guide through the labyrinth of plant forms, we may come to some glimmer of light.

Naturally, the lowest group would contain those plants in which no sexual reproduction has been discovered. In recognition of this position, as well as their probable position in point of time, they have been called Protophytes, or "first plants." The lowly character of lacking sexual reproduction is further borne out in their structure, for they are mostly one-celled forms. In this group stands Protococcus as a type, a single-celled chlorophyll-bearing plant with no discovered sexual reproduction; and, as degenerate representatives, the bacteria and yeasts. You will notice, however, that the definition of this group, on the basis we have adopted, is a negative one, being not as much what we have found, as what we have not found. It follows that this group furnishes a kind of limbo to which all one-celled plants are consigned, in case no sexual reproduction is found, a sort of unresolved nebulous mass, in fact, a cloak for ignorance. It is like the man who undertook a great scheme of classification, and made his two principal divisions "things that I know" and "things that I don't know." The first group he could classify reasonably well; the second he did not have to classify.

In this lowest chamber of Protophytes, every now and then the garment of sexual reproduction is discovered, and its wearer invited to take a place in some upper chamber. But the chances are that the chamber will never be completely emptied, and that there will always be some plants called Protophytes.

In the second group we would expect to find the beginning of sex-reproduction in its simplest form; and to understand what the simplest form would be, the nature of sex-reproduction must be defined. It consists in the mingling of the contents of two cells to form a new one. This new cell is the progeny, and develops more or less directly into the structure of the parents.

Applying this definition to some one-celled form as Protococcus, the simplest possible method of sex-reproduction would be for two cells to come in contact and mutually discharge their contents into a blended mass which becomes a new cell and presently resembles the parents. Such is the beginning of sex-reproduction as we find it in the second group of plants; but it will be noticed that there is no distinction of sex. Both cells are constructed alike and act alike; neither is receptive, for the new cell is constructed upon neutral ground. Sexuality has been attained, but not bisexuality. For this reason, the second plant group is frequently called the "Unisexual Group"; or, from the fact that the cells are for a time yoked together, they are technically called Zygophytes, or "Yoked Plants." In this group, not only is sexuality begun, but bisexuality is hinted at. Plant bodies now begin to consist, not of single cells, but of cell-groups, usually arranged in a chain, forming filiform or thread-like plant bodies. In these filaments or chains of cells, any cell (for they are all alike) can become a reproductive cell and join issues with any other cell, either in the same filament or in another. There is no setting apart of special cells to do this special work, for it is done equally well by all, and all are ordinary vegetative cells. The first hint at bisexuality comes with the fact, that one of these conjugating cells becomes receptive, receiving the contents of the other, and within it the spore or progeny cell is formed.

Such is the case in the common Spirogyras, or "frog-spittles." Although one cell becomes receptive, there is no difference in form nor in contents, and it seems immaterial which becomes the receptive one. In other forms, the development of the spore within the

receptive cell demands more or less change of form, thus making a cell differing in appearance from the ordinary ones. To sum up the general phases of this advance in the second group, or Zygophytes; sexuality is attained, at first with no distinction of sex; then one cell becomes receptive, but differs in no respect from any other in form or contents; and finally, the receptive cell becomes more or less changed in form by the development of the spore.

In the third group we would expect to find bisexuality distinctly worked out, but of the simplest kind. The simplest kind of distinct bisexuality would consist in setting apart two cells for the special performance of this function, differing from the ordinary cells of the plant body and from each other in form and contents. Naturally the receptive or female cell, in which the spore is to develop, would be the larger, probably the largest cell produced by the plant. Such is the average condition of sexuality in the third group, called Oöphytes, or "egg-spore plants," in reference to their large spores. It is to be noticed that these male and female cells differ in form and function only from the ordinary cells of the plant body; they are not favored and cared for by any sort of protection. At this point we are confronted by a phase that needs explanation. The life-history of every plant may be considered a cycle, from the spore which produced it round to the spore which it produces. The cycle is traveled continuously without cessation, except at some one point, which is known as the "resting stage." Every plant, in the life cycle referred to, must, at some point, pass through a resting stage, in which condition the plant activities lie dormant, as if to gather strength for the rest of the journey. This stage must always be a protected one, protection which not only shuts out adverse external conditions at a time of low vitality, but prevents response to favorable ones until after a certain lapse of time. In the groups already considered, this resting stage occurs at the spore phase. The protection provided is simply a thick heavy wall about the spore itself; and in this condition the plant exists for a time and then runs its cycle, round through parent form to spore again. To pass through the resting stage at the spore phase is characteristic of a low type. In the third group the resting stage is pushed gradually forward, until the sex-spore becomes, not a rather permanent phase, but simply one of the transient phases, the resting stage occurring after the spore has developed subsequent structures.

The next phase in the sex-reproduction, the one naturally expected in the fourth group, is the protection of the male and female cells or organs. Set apart heretofore in form and function, they are not protected; but in the fourth group this is gradually and at length very completely provided for, as indicated by the group name, Carpophytes, or "plants with spore cases." In certain members of the group—those which look towards Oöphytes—the male and female cells are at first as naked as in Oöphytes, and if the spore passed into the resting stage the plants would belong to that group; but the spore, as soon as formed, proceeds to develop other structures, and, along with the female cell in which it is contained, develops a complex structure called a spore-case, and this is the resting stage.

Summing up the advance made in the fourth group, we find male and female cells distinct in form; the latter finally protected; and the sex-spore ceasing to be the resting stage, and becoming an evanescent phase which passes directly into a complicated structure, which itself is the resting stage. Subsequently, from this complicated structure, or "spore-case," forms like the parent plant are produced by means of so-called spores, not formed by sex-union, but by ordinary cell division, and for that reason called asexual spores. They are simply reproductive bodies cut off from the parent stock, and are chiefly for the dissemination of the plant, no more a product of the sex act than the buds used in grafting or the "slips" in transplanting; but they are the "spores" commonly spoken of among cryptogams, and their name is legion. The essential difference between sexual and asexual spores cannot be too strongly pointed out, for they have led to endless confusion of ideas. Note now the relation of things in this fourth group. The sex-spore produces the structure called the spore-case, which in turn produces asexual spores by ordinary cell division, which in turn reproduces the original parent. In this group, therefore, in the effort to protect the progeny the resting stage was pushed forward, and that condition of things known as "alternation of generations" originated. As a result, we have in a single life-cycle two plant phases, each producing spores, but in a very different way. One phase bears the sex-organs and produces the sex-spore, and hence is called "the sex-plant;" the other is produced by the sex-spore, bears no sex-organs, produces asexual spores, and hence is called

"the asexual-plant." The asexual spores produce the sex-plant again, and so the cycle is completed. The idea of protecting the sex-organs or their progeny, begun in the fourth group, becomes more and more fully developed in the groups above. After the covering to the female-cell is established there remains a neck-like passage-way. This passage-way becomes more elongated, and more or less guarded, until in the highest group it too is completely blocked up by loose cellular tissue, which must be penetrated by what is called the "pollen-tube."

To summarize at this point: we have an asexual group as the lowest; then a unisexual group; then a bisexual one; bisexuality appearing as the goal in the first three groups. In the fourth appears the idea of protection, which gradually becomes more and more perfected in method, until, without any sensible break in the series, we reach completest protection in the seventh group, or Phanerogams. Also in the fourth group, after bisexuality had been attained, we find alternate generation, and it is in the development of that character that we find the most striking line of advance from the fourth group to the seventh. Keep in mind that the same road is also completely graded and bridged by way of "protection," as has been already referred to. Given, then, as our starting-point (1) a sex-plant which carries sex-organs and produces a sex-spore; and (2) a resulting asexual plant which produces asexual spores; and remembering that the two are but arcs of the same circle and alternately produce each other, what is the next complication that indicates advance?

The next step, besides the completer protection already referred to, is the completer setting apart of the two phases, so as to make them in structure what they are in function, distinct plants. In members of the fifth group, mosses for instance, we find this to be the case. The ordinary moss-plant, which bears the sex-organs, is, of course, the sex-phase; and borne upon it, though as organically distinct as if it grew upon any other mechanical support, we find the structure which develops from the sex-spore, the so-called "fruit," or spore-case. This is the asexual phase, and produces within itself asexual spores (the only spores meant in the ordinary description of mosses). These spores, in turn, produce the sex-phase, or ordinary moss-plant, and the cycle is complete. There is here a distinct setting apart in function, and, as usually follows, in

form also. To the one phase is assigned sex-reproduction ; to the other the dissemination of the plant by asexual spores. The ordinary vegetative structures, representing root, stem, and leaves in the higher groups, are here included in the sex-phase also ; so this phase is the prominent one, the one ordinarily observed and spoken of as "the plant ;" while the asexual phase is more inconspicuous, and, being mechanically borne on the other, seems to be but a part of it.

From this point on, the tendency is to confine the sex-phase more and more entirely to the business of sex-reproduction, and to transfer the vegetative structures more and more completely to the asexual phase. The result is, that as we advance towards the higher groups the sex-phase becomes less and less prominent, as the function is taken away from it which involves size and display ; while the asexual phase, taking on the function involving display, becomes more and more prominent, and is popularly styled "the plant." So that, while "the plant" in the case of mosses is the sexual phase in the life-cycle, "the plant" in higher groups is very probably the asexual phase, representing the so-called "fruit" of the moss. As the sex-phase is to be more and more confined to sex-reproduction, it can easily be understood how it can be reduced more and more, until it has only the cells actually needed ; and these cells may be reduced to two, one to represent the plant, and the other the sex-organ growing upon it. This seems to represent the goal set before the sex-phase, when in the sixth group the vegetative structures begin to leave it. From this point on evolution reduces and simplifies the sex-phase, increases and makes more and more complex the asexual phase. The sex-phase thus begins simply in the lowest groups and ends simply in the highest, reaching in the fifth probably its greatest complexity. While this is true of the structure of the sex-phase, it is not true of the sex-function, for the very highest possible degree of differentiation in this regard is attained in the highest group.

In the sixth group, represented by ferns and their allies, we find a very wide distinction between the sexual and asexual phases ; the latter having become very prominent and having possessed itself of most of the vegetative structures, being the ordinary fern-plant, with its great display of vegetative structures and asexual spores, but no sex-organs. Linnæus may well have examined

the fern in vain for any evidence of sex-organs, for he only knew of this prominent asexual phase, and in his despair consigned the group to "Cryptogams," "hidden sexuality." The asexual spores (borne, you may remember, upon the leaf-structures of the fern) develop, of course, into the sex-phase; but that is so small and hidden among the mold in which the spore has fallen, that it may well escape observation. It is simply a minute flat disk-like body, with vegetative cells and root-like processes enough to make it able to live long enough to accomplish its function of sex-reproduction. But it bears the sex-organs, produces the sex-spore, and from it there arises the beautiful or stately asexual plant. The reduction of the sex-phase could go no further than this, and at the same time compel it to make its own living from soil and air. If any more reduction be made, the sex-phase cannot be organically separated from the other, but must depend upon it for elaborated food.

By this means the utmost possible reduction could be reached, and we must expect this to be the next step in advance. For instance, the asexual spores of the fern are scattered over the soil. From them springs the reduced sex-phase, known as the prothallium, and capable of independent existence. Any further reduction, which would make it incapable of independent existence, would necessitate that the asexual spore be not separated from the asexual plant, but developed into the prothallium upon it so as to receive elaborated nourishment. The reason why a prothallium cannot be indefinitely reduced, and still retain the power of independent existence, is not far to seek. It is on the same principle that a small battery cannot work an indefinite amount of wire. The formation of high-grade reproductive cells is an exhaustive work, and it would require more than a few cells to manufacture such an amount of highly organized substance from crude material. Hence we reach a point, beyond which it would be a physical impossibility to reduce the prothallium, without arranging to supply it with material already highly organized.

Remembering, then, that from the sixth group, represented by ferns, higher rank is to be marked by a reduction of the sex-phase or prothallium, which finally cannot be separated from the asexual plant, let us note a new phase of differentiation which begins to be prominent in the upper members of the sixth group, and continues

as the highest expression of differentiation in the seventh and last. Although vegetative organs have departed from the sex-phase, there still remains a double function, namely, the production of male and female cells or organs. It seems to be a law, that so long as anything remains to be differentiated, differentiation will continue; and the separation of the sex-organs is its next possible expression. Instead, therefore, of having a single prothallium bearing both male and female organs, we find two prothallia; one male and the other female. This state of things is reached by one set of organs first becoming functionless, and finally being suppressed. Remembering that these prothallia are developed from asexual spores, it does not seem strange that this diœcism extends presently to these spores themselves, and that we soon find what may be styled (from the nature of their product) male and female asexual spores. This brings us to the heterosporous arrangement, a feature which continues to the last, and which must be considered a high-rank character, possessed only by the higher members of the sixth group, and by the seventh; and yet, through the very midst of this condition of things, accompanied as it is by many intergrading characters in all the other plant structures, the old abyss between Cryptogams and Phanerogams was supposed to run. To sum up the lines of advance, with which we enter the group Phanerogams, we find male and female spores, producing male and female prothallia, and those prothallia so much reduced that not only do they not become separated from the asexual plant, but are developed within the asexual spore itself. But these same important characters are to be found among the highest Cryptogams, and we must conclude that any line of separation is one of our own drawing, and has no representation in nature.

It remains to apply to the well-known parts of any flowering plant the terminology that we have been using in outlining the evolution of the sex-apparatus. The asexual phase, or part of the cycle, is "the plant" with its rich display of vegetative organs, consisting of root, stem, leaves, and their various modifications. This asexual phase produces asexual spores of two kinds, called male and female, because they are to produce male and female prothallia. It would be an interesting line of development to note the gradual differentiation of the apparatus for making these asexual spores, but that is aside from our purpose. The

final result is, that in the flowering plant we are considering, highly specialized sets of organs produce the two kinds of asexual spores, which have been called pollen-grains and embryo-sacs. It seems strange to be forced to give up pollen-grains or embryo-sacs as sexual affairs, for in our old notion of things they represented the very essence of sex; but the fact remains that they are asexual spores and simply give rise to prothallia which bear the sex-organs and give rise to the sex-spore.

The two prothallia which are developed from these asexual spores have reached the highest degree of reduction, developing within the spores themselves. In the case of the pollen-spore two or more cells are developed, which may be easily seen by the use of the proper reagents, and this small group represents the male prothallium, one of the sex-phases in the life cycle. This much reduced plant sets apart one or more of its cells to do vegetative or growth work, and another to be the male organ. A very vigorous growth of this prothallium is demanded in the development of the pollen-tube, through which the male cell discharges its contents. This pollen-tube does not usually find an open passage-way, but one that is blocked up with spongy tissue, called "conductive tissue," through which it makes way like a parasite invading the tissues of a host plant.

In the case of the embryo-sac, the female asexual spore, the development of the prothallium is still feebler, the cells representing it not only being few in number, but free from each other,—a sort of disorganized tissue. The cells representing the female organs are clustered near the apex of the embryo-sac, forming what we now call the "egg-apparatus," while those that probably represent the vegetative cells of the prothallium are clustered at the other end of the embryo-sac, and are styled "antipodal cells." In pines, representing the lowest group of flowering plants, the female prothallium is a very distinct and compact tissue, bearing regulation female organs, the so-called "corpuscula." This but shows their position upon the lower border line of Phanerogams. The sex-phase in the life cycle, therefore, which in mosses stood for the whole plant as we ordinarily recognize it, in Phanerogams has become reduced to little clusters of cells developed within the pollen-spore and embryo-sac, so inconspicuous that it has remained for the modern reagents to discover their existence. The real sex-

spore, or oöspore of Phanerogams, is the single fertilized cell in the embryo-sac, which at once develops into the embryo, at which point Phanerogams pass into the resting stage, in this group called "the seed." The sex-spore, since the fourth group, has become such an evanescent thing, so out of reach of common observation, that very naturally it has been the common opinion that the comparatively permanent asexual spores are sex affairs. Sex-spores are directly formed by sex-union; while pollen-grains and embryo-sacs are never formed in any such way. Thus have I hastily traced one of the principal threads upon which our botanical facts are strung. And as one examines the subject in more of its details, he becomes irresistibly impressed with the idea that here is a great scheme of development, directed by laws of which we are beginning to catch glimpses, and by which the whole fabric of a great kingdom has been beautifully and continuously worked out.

RECENT LITERATURE.

The Geological History of Plants. By Sir J. William Dawson, C.M.G., LL.D., F.R.S., etc. International Scientific Series. New York, 1888.—This book is a striking example of the truth that scientific specialists cannot be induced to say much about things which they have not themselves carefully studied. Purporting to treat a great department of palæontology from a cosmopolitan standpoint, it is really a summary of the author's own extensive researches within the British American Provinces, enriched by much comparative matter drawn from similar phenomena in other lands. What is therefore lost in generality is gained in thoroughness and reliability. There is no branch of science that stands more in need of summarizing and systemizing than that of palæobotany, and every book that successfully attempts this should be warmly welcomed. With the above qualification this work does this, and it is therefore a valuable contribution to the thus far scattered and desultory literature of the subject. Taking up the several geological formations in their ascending order, the characteristic vegetation of each is ably portrayed by the author, though with an unevenness of treatment corresponding to the imperfection of the geological record in the region to which he has devoted his life. The vegetable origin of the Laurentian graphite is defended with great force, and the existence of a primordial flora contemporaneous with *Eozoon canadense* is maintained. Most of the alleged

plants of the Cambrian and Silurian seas are thrown out, but Nematophyton, Protannularia, and some species of Buthotrephis are marked as genuine. A special feature is the working out more elaborately than in any other place of his theory of an early Rhizocarpean flora culminating in the Devonian. Much space is given to the flora of this period, so well developed in Acadian territory, and so unimportant in other countries, and his name "Erian" is constantly used and specially defended. The Carboniferous flora takes a subordinate rank, but the extended notes to that chapter are crowded with valuable information, much of which would be new to any but the thoroughly informed specialist. The early Mesozoic (Triassic and Jurassic), not being represented in Canada, is given a very short chapter, largely devoted to the history of Ginkgo and Sequoia as worked out by Heer, Saporta and others. More prominence is given to the Cretaceous, and the interesting plant-bearing deposits of the Kootanie (Neocomian), Dunvegan (Cenomanian), and Belly River (Senonian) series in the Northwest Territories receive special attention. The Laramie group, as it occurs on the St. Mary River, on Willow Creek, and on Porcupine Hill, is also well characterized and illustrated. The great Miocene flora, which ranks next in abundance to the Carboniferous, is passed over nearly in silence, but some very important deductions are drawn from the little florula on Green's Creek, central Canada, in the Leda clay, believed by him to have been deposited at about the time of maximum glacial refrigeration. The work closes with a chapter on the origin and migration of plants, and the relations of recent to fossil floras.

In this book Sir William Dawson naturally takes occasion to give his views on most of the disputed questions in phytopalæontology. A few of the more important of these may be mentioned here: He accepts and reiterates the Brongniartian hypothesis of the greater abundance of carbon dioxide in the atmosphere during palæozoic time, but without denying the possibility of the cosmical origin of portions of it, as maintained by Dr. T. Sterry Hunt. He insists upon the substantial uniformity of the fossil floras, especially the Palæozoic, over the whole globe, and expresses his convictions that, "with reference to the Erian and Carboniferous floras of North America and of Europe, the doctrine of 'homotaxis,' as distinct from actual contemporaneity, has no place." He agrees with Gardner that the Laramie group is probably of the same age as the arctic Miocenes of Heer, and that these are not Miocene but Eocene, also that allowance should be made for differences of latitude, although this is not sufficient to amount to an entire geologic period. On the leading taxonomic question as to the position of Sigillaria, he accepts Williamson's proof of the existence of truly exogenous cryptogams, but from the frequent occurrence of taxine fruits in the same beds with Sigillarian

trunks he inclines to the opinion that these will yet be found attached, and that some forms, at least of Sigillararia, must have been coniferous. In this connection he discredits the statements of Goldenberg relative to the fruits of Sigillaria, but seems to be unacquainted with the important paper of Zeiller, which has certainly done more to settle the question than any other discovery.

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GEOGRAPHY AND TRAVEL.[1]

AMERICA.—THE RIO DOCE.—The Rio Doce, Brazil, an account of the exploration of which was recently read by Mr. W. J. Steains before the Royal Geographical Society, appears small when compared with the mighty rivers around it, yet has a length of rather over four hundred and fifty miles. Its head-waters are several streams rising in the Serra da Mantiqueira, the loftiest peak of which, Itatiaiaassu, 10,040 feet, is the highest known elevation in Brazil. The various streams which unite to form the Rio Doce flow in a more or less northerly direction from the northern slope of the Serra and unite into a main river which, after receiving several tributaries, enters the ocean at about 19° 40′ south latitude. The Serra da Mantiqueira has a general northeast direction, but the irregular line of the Brazilian coast-range is continued northward by the Serra dos Amore, which is cut through by the Rio Doce in its descent from the interior table-lands. The part of the Rio Doce basin lying east of the last named Serra is a densely wooded lowland, sloping upward to a height of about nine hundred feet, and resolving itself near the coast into a stretch of alluvial ground, studded with small lakes communicating by long winding streams called "valloes." The largest of these, the Lago Juparana, is eighteen miles long, and is connected with the Doce by a tortuous channel of about seven miles. It is fed by the Rio San José, a still unexplored stream, flowing through districts inhabited by wild Botocudos. The forests around it abound in the Jaearandá (*Bignonia cœrulea*), or rosewood tree. The Rio Doce is navigable as far as Porto de Sonza, one hundred and twenty miles from its mouth. Here occur the rapids which mark the crossing of the Serra dos Amores, and falls and rapids are abundant above this. There are, as yet, only three settlements—Linhares, Guandu and Figueira—on the banks of the Doce, though for the greater part of its course grand virgin forests, filled with a hundred varieties of

[1] Edited by W. N. Lockington, Philadelphia, Pa.

the choicest timber, come down to the water's edge in a wall of gloriously wild tropical vegetation. The valley is the home of the Botocudo, who has not yet renounced cannibalism. Mr. Steains does not place the number of these Indians at more than seven thousand, yet states that they form the sole barrier to colonization. Espiritu Santo, the province lying east of the Serra Amores, is at present the poorest province in the empire, and the valley of the Rio Doce is a great gap in the wall of civilization that has been slowly reared along the four thousand nine hundred miles of the Brazilian seaboard. There is not in Brazil a tract naturally richer than that which lies between the Doce and the Mucury to the north of it, yet the Indian is still in possession.

The Botocudos, so called by the Portuguese on account of the "botoque," or lip-ornament, which is the only clothing worn by them, are about five feet four inches in height, broad chested and lean limbed, and with small hands and feet. The plug of wood is first inserted in the under lip when the Indian is three or four years old, and is replaced by a larger until a diameter of three inches is attained. If the lip splits the Indian ties the ends together with bark. The "botoque" is now worn only by the older members of the tribes. The nuts of two or three species of palm form the chief sustenance of these primitive people, and the supply is eked out with game and fish. Mr. Steains ascended the tributaries Tambaquary, San José, Pancas and Rio San Antonio.

In the discussion which followed the reading of Mr. Steains' paper, Mr. C. Mackenzie stated that the custom of wearing an ornament in a slit made in the lower lip could be traced with very few breaks from the Eskimo of the Alaskan coast to Brazil.

THE CASSIQUIARI.—M. Chaffanjon, the well-known explorer of the Orinoco, has carefully studied the communication between that river and the Amazon, by means of the Cassiquiar, and comes to the conclusion that it is of recent origin. The rapid current of the Orinoco, as it passes through a gorge only ninety yards wide in the clay deposits, undermines the banks, and this action, combined with actual overflow in the rainy season, has produced a permanent channel. The clay deposits on the left bank have a slope towards the Amazon.

ASIA.—EXPLORATIONS IN NEPAL AND TIBET.—An adventurous journey through Nepal and Tibet has recently been taken by M. H., a native explorer attached to the East Indian Survey. Disguised as a physician, and provided with a stock of medicines and articles for presents, he ascended the Dudhkosi river through Nepal to Khumbujong, about eighteen miles west of Mt. Everest. The governor refused him further passage, but he succeeded in curing that functionary's daughter-in-law of goitre, and soon after started with her husband on a trading expedition into Tibet. The pass

over the Himalayas, called the Pangula, is about 20,000 feet above the sea. More obstruction was met with at Deprak, the frontier village of Tibet, but leave to advance was at length obtained from the governor of Dingri, who exercises all civil and military jurisdiction over a large tract of Southern Tibet. Dingri has about 250 stone houses, and stands at an altitude of 13,360 feet. From Dingri the explorer proceeded by the Digurthanka plain and Palguche lake (said to have no outlet) to Jonkhajong, the most northwestern point reached. Hence he went southwards to Kirong, followed the Tusuli river for awhile, visited Nubri and Arughat (Nepal), and finally, via Deoghat, reached Tirbenighat, on the British frontier on Jan. 13, 1886. Beyond Kirong, on the Nepalese frontier, the road runs along a gallery of planks laid upon iron bolts driven into the rock. Parts of the plain of Southern Tibet show signs of a former larger population, and it is said that in the last great war between the Nepalese and the Tibetans most of the inhabitants were killed.

Dr. von Luschan's Journey in Asia Minor.—At a recent meeting of the Geographical Society of Berlin, Dr. von Luschan spoke of his explorations in Asia Minor, undertaken chiefly with archæological aims. Dr. Luschan accompanied Otto Bensdorf into Lycia in 1881, and afterwards visited the tomb of Antiochus I., discovered by Otto Predestein in 1882. This is an immense tumulus on the right bank of the Euphrates, between Iskenderun and Bagdad, on the peak Nemrud Dagh (7000 feet). The tumulus is flanked on the east and west by five gigantic figures of gods, sixteen to twenty-three feet high. At a distance of ten days' journey from the coast, the traveler along this route comes upon the ancient bridge over the Boilam-Su, a single stone arch, sixty-five feet in height and 325 in length. It was built by Septimius Severus, Carracalla and Geta, and is to-day in perfect preservation. Afterwards Dr. Luschan took part in the expedition of Count Lanckoroviski, the object of which was the archæological exploration of Cilicia and Pamphylia. In other later journeys Dr. von Luschan turned his attention to the complicated ethnography of Asia Minor. The Turco-Mongolian anatomical type is not to be found among the so-called Turks of Asia Minor. The Mohammedans of the peninsula belong to three types, viz.: Old-Grecian, Armenian and Semitic. The race which gave the religion and language was numerically too weak to influence, to any considerable extent, the physical nature of the conquered people. The Greeks exhibit the same three types, the true Greek predominating along the west coast and on the islands. The Armenians are a compact and homogeneous people, anatomically allied to the Tachkadschy or Alleor of Lycia, the Ansarieh or Fellach of S. E. Asia Minor

and N. Syria, and the Kizilbash and Tezyde of Upper Mesopotamia and Kurdistan. The Turukes are genuine nomads, traditionally from the Hindu Kush. Turcomans and Kurds also occur, besides Bulgarians, Arnauts, Arabs, Gypsies, Europeans and negroes, all of whom have immigrated in comparatively modern times.

Africa.—The recent journey of Bishop Parker and the Rev. J. Blackburn from Mombasa to Mamboia, a point situated about 200 miles east of the port of Saadani, fills up another gap in the map of Africa. The region proved to be one of the most varied, mountainous, and richly wooded on the continent, and seems to be a succession of high ridges and valleys. The regions passed through were those of Usambara, Useguha and Nguru. Southeastward of the route taken by the previously named gentlemen, Count Pfeil has been actively engaged in exploring Useguha, along the lines of the Rufu and its tributary, the Mkomazi; then south to the basin of the Wami. From Mbnzini, on the Rukagura, he proceeded southwards across the plains between the Wami and the Geringeri, and then followed the course of the latter river to its junction with the Kingani, finally reaching the coast at Bagamoyo.

Geographical News.—M. Thonar, who was believed to have perished in the Gran Chaco, has returned to Port Pacheco with his companions.

It now appears that Dr. Meyer did not ascend to within 2000 feet of the summit of Mt. Kilimanjaro.

The volume of water discharged every second by Lake Baikal through the Angara reaches 121,353 cubic feet, and the vertical section of the river at its issue is, according to the *Izvestia*, 17,920 feet.

Gen. A. Houtum-Schindler (*Proc. Roy. Geog. Soc.*, Feb. 1888), gives a summary of the various barometrical and trigonometrical observations that have been made at the altitude of Demavend, the highest peak of the Elbruz Mountains (Persia), and arrives at a result of about 19,400 feet. Although no eruption of Demavend is on record, smoke, or at least steam, has been stated to have been seen to issue from it.

GEOLOGY AND PALÆONTOLOGY.

NOTES ON THE DRIFT NORTH OF LAKE ONTARIO, is the title of a paper read by Professor J. W. Spencer before the Phil. Soc., Washington, March 3d. This short paper is a generalized description of some of the obscure and conflicting phenomena of the drift, of which this notice is an abstract.

Amongst the deposits of the later Pleistocene period, there is a well stratified, hardened, brown clay, charged with pebbles which are more or less glaciated, resting upon the typical blue boulder clay, north of Toronto. In the Canadian classification of the Pleistocene deposits there is no place for this deposit. Indeed, all of the stratified deposits of this region need revision in the light of the progress that has been made in surface geology during the last twenty years. Thus the Saugeen clay is resolvable into three series. The relation of all the clays to the older beaches require special study, as a part of them probably represent the deep water deposits of the Beach epoch, while some of the later beaches rest upon such clays. Around the head of Georgian Bay there are ridges, in the form of moraines, similar to those about the other Great Lakes, reaching to the height of 1300 to 1400 feet above the sea. From the face of the Niagara Escarpment—between Georgian Bay and Lake Ontario—there extends, for over a hundred miles, to near Belleville, a broad zone, of from eight to twenty miles in width, covered with drift ridges, composed of stony clay below, and frequently stratified clay or sand above, having an elevation of 1100 to 1200 feet above the sea, with occasional reductions to 900 feet. These "Oak Hills or Ridges" rise from 300 to 500 feet above the Palæozoic country to the north. The stones in the clay are often glaciated limestone, with only a small proportion of crystalline pebbles or boulders. In the deposits of the ridge native copper has been found; consequently the drift-carrying agent moved southeastward down Georgian Bay, to the west end of the Oak Ridge, and probably throughout its whole length. North and east of Belleville there are many lower and fragmentary ridges, having a trend somewhat across that of the Oak Ridge. The glaciation of the region adds great difficulties to the explanation of the phenomena. The striation in the Ottawa Valley, from Lake Tamiscamang to the junction with the St. Lawrence, is to the southeastward, with very rare local exceptions. Of the Niagara escarpment, between Georgian Bay and Lake Ontario, from 1600 down to 700 feet above the sea, the striæ are also to the southeast; but between these widely separated regions the surface marking of the rocks are

obscured to the west and south by drift, and to the north and east absent or rarely seen, although the crystalline rocks are commonly rounded or very rarely polished, an absence that can only in part be accounted for by subsequent atmospheric erosion. About the St. Lawrence and Lake Ontario the striations are to the southwest or west. Between the Ottawa River and Georgian Bay there is a high prominence, which divided the drift-bearing currents. But north of Lake Huron the glaciation is very strongly marked, and the direction is to the southwest, with very rare local variations.

All the lobes of glaciation about the lakes, from Superior to the Ottawa Valley, radiate backward to the broad and open but low basin of James (Hudson) Bay. The watershed between the lakes and Hudson's Bay during the epoch of the formation of the drift was several hundred feet lower than now—which is about 1600 feet at present—as shown by the differential elevation of the beaches. For this conflicting phenomena of the drift no explanation was offered, but rather sought for.

Some remarks upon the paper were offered by Mr. Gilbert, who had observed the slight amount of erosion in the Ottawa Valley; but he thought that generalized explanations of the drift were very often contradictory when applied to special regions, and that our knowledge of the phenomena would not at present give a satisfactory explanation.

GLYPTODON FROM TEXAS.—In the *Proceedings* of the Philosophical Society for 1884, p. 2, I recorded the discovery of a species of Glyptodon in the valley of Mexico by Professor Castillo, which was at the time the most northern locality at which the genus had been discovered. I can now announce its discovery within the limits of the United States, in Nueces Co., Southern Texas, by my friend, Mr. William Taylor, in the beds which have yielded *Equus crenidens* Cope and *E. barcenæi* Cope, both species of the valley of Mexico.

The present species is represented but by a single segment of the carapace, but as the sculpture of these elements is very characteristic, and as my means of comparison are very large, since my Pampean collection embraces a majority of the species, I venture to describe it. It belongs to the group in the genus represented by *G. clavipes* Owen, and *G. oweni* Nodot. It is a species of large size, with very thick carapace, and with the circumferential areas of the rosette but little smaller than the central one. The former are regularly pentagonal, the latter regularly hexagonal, and they are separated by well-defined grooves. Deep foramina very few. The surface of the areas is flat and in one plane. The texture of the median area differs from those round it in being impressed with numerous small, closely-placed foramen-like fossæ. Its surface supports no tuberosities. The circumferential areas are marked

with shallow grooves, which issue abruptly near the median border and radiate towards, and some of them to, the circumference, becoming shallowed externally; no tuberosities. Diameter of scutum, 45 mm.; of median area, 17 mm.; thickness, 15 mm. This species is of the same type as that one found in the valley of Mexico, but I cannot speak positively as to its identity. It may be called *Glyptodon petaliferus*.—*E. D. Cope.*

GENERAL.—According to A. W. Stelzner, the Archæan rocks, primitive gneiss, and primitive slates compose the greater part of the sierras which rise out of the Pampas; but granite occurs in most of these sierras, especially in that of Achala. This granite must certainly be pre-Silurian. The principal locality of the Silurian rocks is in the Anti-Cordilleras. Devonian and Carboniferous rocks have not hitherto been found in the Republic, but, possibly, the Carboniferous strata of Southern Brazil and Uruguay may extend into the Province of Corrientes. The Dyas and Trias have, also, not been palæontologically identified. The red sandstone which D'Orbigny believed to be Triassic has been since referred to the Upper Jurassic or to the Cretaceous. Rhætic beds have been found near Mendoza and in the Famatina Mountain, etc. Jurassic beds are exposed in the Espinazito Mountains, and a Jurassic sea extended from the eastern coast far into the interior. The gypsum-bearing sandstone of the passes of Patos and Cumbre belong to the Cretaceous formation, as do also the red sandstone of the Province of Tucuman and that of Jujuy.

PALÆOZOIC.—Hans Reusch (Sep.-Abd. a. d. neu. Jahrbuch für Min., Geol. u. Pal.) describes the geology of a metamorphosed district on the Hardangerfjord, in Norway. The region treated of is on the west coast of Norway, south of Bergen. The foldings of the strata (as shown in the wood-cuts) are most singular. Granite rocks show laminations, are set with blocks of gneiss, or are twisted in inextricable confusion; conglomerates are so compressed that the pebbles form narrow lines; granite forms dykes in diorite, and the whole region is a maze of conflicting strikes and dips.

CÆNOZOIC.—The ninth volume of the Bulletin of the National Academy of Sciences of Cordoba (Argentine Republic) contains descriptions of numerous mammalian fossils from the Tertiary strata near the Parana. Among these are *Cynonasua argentina*, a form allied to the coati, but with seven molars in the lower jaw; a Canis, of about the size of *C. azaræ;* a catlike animal, for which Ameghini forms the genus Apera, and which appears to have been about twice the size of the domestic cat; six species of the rodent genus Megamys,—one of them of almost gigantic size; *Epiblema horridula*, a rodent a little larger than the viscachia; two or three species

of the new genus Tetrastylus; two each of Morenia and Orthomys; *Myopotamus paranensis; Plexochœrus paranensis,* previously described as a Hydrochœrus, but differing from that genus in the structure of the last molar; two forms of the new genus Cardiatherium, etc., etc. Many already known species and genera—such as Toxodon, Paradoxomys, etc.—receive additional elucidation in this text. *Macrauchenia bravardi* and *M. rothii* are separated, under the generic name of Scalabrinitherium; while *Oxyodontherium zeballosi* is equivalent to the *M. minuta* of Burmeister. *Promegatherium remulsumis,* a sloth-like animal, nearly as large as *Megatherium americanum;* and *Pseudolestodon æqualis* is another huge sloth. *Comaphoras concisus* and *Proëuphractus limpidus* are among the new loricate edentates. Remains of Cetacea are abundant in marine beds which overlie the fresh-water strata.

Pleistocene.—Dr. Alfredo Dugès describes in a recent number of *La Naturaleza* a Pleistocene fossil, which he names *Platygonus alemanii.* The skeleton appeared to be complete, but was in great part destroyed during the excavation. The animal was almost double the size of the modern peccary.

MINERALOGY AND PETROGRAPHY.[1]

Petrographical News.—The very interesting paper by Brauno[2] on the palæopicrite of Amelose, near Biedenkopf in Hessen Nassau, contains a full description of this rock and its numerous alterative products. The freshest type of the palæopicrite is composed of idiomorphic olivine, augite, both idiomorphic and allotriomorphic, irregular grains of plagioclose, picotite and magnetite. The augite often shows the unusual alteration into biotite. The principal alteration products of the rock are serpentine, siliciophite, chrysolite, metaxite, picrolite, webskyite,[3] calcite and quartz. The three substances chrysolite, metaxite and picrolite are studied in great detail, and their optical and physical properties are described at length. The author regards them each as a variety of serpentine, the first consisting of slender elastic fibres, the second of coarse stiff needles, and the third being characterized by a radiating structure.

The serpentines, amphibolites and eclogites from the neighborhood of Marienbad, in Bohemia, were formerly regarded as sedimentary beds which had been metamorphosed by the action of granite, which occurs near them in a boss. Patton has recently examined these rocks very carefully. He considers[4] them as prob-

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Maine.
[2] Neues Jahrb. f. Min., etc., B. B. v., p. 276.
[3] American Naturalist, Nov., 1887, p. 1021.
[4] Min. u. Petrog. Mitth., 1887, ix., p. 89.

ably the result of the action of dynamic agencies upon eruptive rocks. The serpentines are shown to be derived from a peridotite, composed sometimes of bronzite, hornblende and olivine, and at other times essentially of olivine and tremolite. Different specimens of amphibolites contain zoisite, epidote, augite and talc. The most interesting rocks discussed in the paper are the eclogites. A variety which the author calls kelyphite-eclogite is made up of garnets and hornblende in a groundmass consisting of amphibole and omphacite, so intergrown as to imitate the granophyre structure of certain acid rocks. The garnets are frequently surrounded by a rim of hornblende and plagioclose, which, however, the author is disinclined to regard as a reaction rim, but is rather disposed to look upon as a growth around the garnet as a center. Zoisite, which is also found in these eclogites, is often seen in the thin section to be surrounded by a rim of cloudy substance, which under high powers is resolved into plagioclose, muscovite and a third mineral with the specific gravity and optical properties of topaz, but in which no fluorine could be discovered. Patton supposes it to be an unknown mineral with the composition $Al_2\ Si\ O_5$.—The saussurite gabbros of the Fichtelgebirge, found in lenticular masses scattered through serpentine layers, which are interstratified with clay slates and phyllites, are regarded by Michael[1] as the result of the alteration of a sedimentary feldspathic gabbro, although it would seem, from his own descriptions, that he would have been equally well justified in concluding that the saussurite gabbro lenses are merely the less altered remains of an intercalated gabbro, whose most altered phases are now represented by the serpentine. The word "saussurite" he would use as a general term to designate a cloudy alteration of plagioclose into two or more distinct minerals. He finds that while in some cases this alteration is into zoisite and serpentine, or some indeterminable mineral, in other cases the new minerals produced are serpentine and a calcium garnet.

Mr. Lawson,[2] of the Geological Survey of Canada, gives an account of the diabase dykes so prevalent in the Archæan region around Rainy Lake. These dykes have a width of from sixty to one hundred and fifty feet. Toward their centers they are composed of plagioclose, augite and quartz, with a greater or less proportion of colorless garnets. The augite appears as an aggregate of little crystals which fill the spaces between the other constituents, and not as one continuous crystal, as is the usual case among diabases. The quartz and garnets are found only toward the centers of the dykes, and are absent at their edges. Idiomorphic enstatite, on the contrary, is a frequent constituent of material taken from the sides of the dykes, and is absent from their centers. The features

[1] Neues Jahrb. f. Min., 1888, i., p. 32.

[2] Proceedings Can. Institute for 1887, and American Geologist, April, 1888.

of these diabases are well worthy of the further study Mr. Lawson proposes to put upon them.—The Rev. E. Hill[1] mentions hornblende schists from the island of Sark, in which he thinks he has found indications of a former bedding and evidences of sedimentation.—Ternier[2] describes very briefly the eruptive rocks of the Mt. Mézeuc region in France, as presenting almost as great a diversity as those of Auvergne. They consist of augite and amphibole andesites, trachytes, phonolitic-trachytes and basalts in the order of their sequence. The basalts are the only ones which are at all widespread in their occurrence.

MINERALOGICAL NEWS.—New analyses of several rare minerals are communicated from the laboratory of the University of Virginia. Mr. R. C. Price[3] found a lump of *tscheffkinite*, from Nelson county, Va., to possess the composition $2\ R\ O.\ R_2\ O_3.\ 5(Si\ Ti)_2\ O_2$, in which $R = Ca, Be, Fe, Mg$, and $R_2 = Ce, Di, La$ and $Fe.'''$
Mr. Walker[4] obtained from *genthite*[5] :—

$Si\ O_2$	$Ni\ O_2$	$Mg\ O$	$H_2\ O$	$Fe_2\ O_3$
55.38	17.84	15.62	10.77	.56

corresponding to $\frac{1}{3}\ H_2\ O + \frac{2}{3}\ [(Mg\ Ni)\ O].\ Si\ O_2 + \frac{1}{3}\ H_2\ O$, a meerschaum (sepiolite) with its magnesium partly replaced by nickel. The mineral occurs in thin layers in a sandstone at Webster, Jackson county, N. C. It is amorphous, of a light apple-green color, translucent and greasy. It has a hardness of 2.5 and a specific gravity of 2.53.—Very similar to the last mentioned mineral is a nickeliferous *talc*, from the same locality, in which Mr. Bachman[6] found :—

$Si\ O_2$	$Ni\ O_2$	$Mg\ O$	$Fe_2\ O_3$	$Al_2\ O_3$	$H_2\ O$
53.91	15.91	19.39	1.46	2.65	6.30

—Perimorphs of *pyromorphite* after cerussite and galena are mentioned by Gonnard[7] as occurring in the lead mines of the Puy-de-Dôme, France. In some cases the pyromorphite exists merely as a thin shell enclosing a hollow space, from which the mineral formerly occupying it has been removed by solutions—The same author describes a shell, composed of little rhombohedra of siderite arranged with their axes parallel, enclosing within itself a solution of ferrous carbonate. He also calls attention to a perimorph of pyrite after calcite.—Hall and Tauss[8] have found the

[1] Quart. Jour. Geol. Soc., Aug., 1887, p. 322.
[2] Comptes Rendus, cv., 1887, p. 1141.
[3] Amer. Chem. Jour., Jan., 1888, x., p. 38.
[4] Amer. Chem. Jour., Jan., 1888, x., p. 44.
[5] Chem. News, xxvi., p. 654.
[6] Amer. Chem. Jour., Jan., 1888, x., p. 45.
[7] Comptes Rendus, cv., 1887, p. 1267.
[8] Min. u. Petrog. Mitth., ix., 1887, p. 227.

baryto-celestite, accompanying the wagnerite at Werfen in Salzburg, to consist of 84.8 per cent. of barium sulphate and 15.05 per cent. of strontium sulphate. Like Professor Chester,[1] they regard the substance as an isomorphous mixture rather than as a definite compound.

MISCELLANEOUS.—*Wollastonite* is most frequently found in nature as a newly formed mineral in metamorphic rocks. It has also been detected as a primary constituent in eruptive rocks. Many experimenters have succeeded in obtaining the mineral artificially by means of wet processes, but until very recently all attempts to produce it in the dry way have failed. Doelter,[2] as the result of his experiments, declared that wollastonite could be produced only by wet methods, or at low temperatures in the presence of water vapor. The bearing of such a statement upon the question of the origin of eruptive rocks, is of the greatest importance if found to hold good. Hussak,[3] however, shows that the mineral can be produced by dry methods. He has succeeded in obtaining little monoclinic crystals of wollastonite by fusing together a mixture composed of three parts of $Ca\ Si\ O_3$ and one part of a glass of the composition $3\ Na_2\ O.\ Si\ O_2 + 2\ Ca\ B_2\ O_3$. When examined under the microscope these crystals were seen to possess all the properties of the natural wollastonite.—The anhydrous manganese hydroxide *pyrochroite* ($Mn\ (O\ H)_2$) has been obtained by Schulten[4] in little hexagonal prisms, perfectly transparent, of a light red tint, and with a negative refractive index. His mode of operation was to warm a little manganese chloride with a large excess of a solution of pure potassium hydroxide, care being observed to prevent the access of air during the operation.—Among the large number of artificial crystals made by the late Dr. Ebelmen, Mallard[5] describes one of some interest to mineralogists. It was produced by fusing together a mixture of silica, glucina and borax. In the resulting product were large numbers of little prisms of a positively refracting substance, which corresponded in its properties with the rare mineral *phenacite* ($Be_2\ Si\ O_4$).—Krüss[6] has found that *euxenite* from Norway contains a tenth of one per cent. of the newly discovered element germanium.—Traube[7] notes that the zeolites found in the Striegau granite are colorless when occurring at great depths, but when near the surface are highly colored.

[1] American Naturalist, 1887, p. 852.
[2] Neues Jahrb. f. Min., etc., 1886, i., p. 119.
[3] Mineralogische und Petrographische Notizen, Bonn. p. 9.
[4] Comptes Rendus, cv., 1887, p. 1265.
[5] Comptes Rendus, cv., 1887, p. 1260.
[6] Ber. d. d. Chem. Gesell., 1888, p. 131.
[7] Neues Jahrb. f. Min., etc., 1887, ii., p. 67.

BOTANY.[1]

THE ROOTSTOCKS OF LEERSIA AND MUHLENBERGIA.[2] — *Leersia virginica* Willd., grows in wet, shady places, and starts rather late in the spring. Late in autumn the parts below ground are found to consist mainly of some slender exhausted and dead rootstocks, from one to three or four centimetres long. The internodes of these slender exhausted rootstocks are covered for a part of their length by sheaths of rudimentary leaves, early bearing a very short blade.

A portion, perhaps one-third, of the nodes bear from one to four thickened, scaly rootstocks, which contain nourishment for starting young plants the next spring. In some cases one or more scaly rootstocks appear near the apex of a similar rootstock which survived the winter.

The surviving rootstocks are slightly flattened, one to four centimetres long by three to five mm. in diameter, covered with scales, and are mostly simple, though some of them have short branches.

The scales are brown, alternating and two ranked, and on internodes which are from one to two mm. long. The bases of the scales are thickened and abound in plant food.

Leersia oryzoides Swartz, also has rootstocks, the main axis of which is not very unlike that of the former species, though in autumn they are rather stouter, and most of them remain alive and gorged with plant food for use on the approach of the succeeding spring. Many of the nodes bear short, pointed, solid branches, with four to eight nodes. The scales of these buds are mere dead rings or shreds, and are not filled with nourishment in autumn.

The fundamental differences, then, between the rootstocks of these two species are as follows:

1. In winter the main rootstocks of *Leersia virginica* are dead, while those of *L. oryzoides* are alive and abound in food.

2. The scales of the rootstocks coming from the nodes of the main rootstocks of *L. virginica* are broad, firm, and full of plant food, while the corresponding scales of the branches of *L. oryzoides* are reduced to mere dead fragments, containing no plant food. No good specimens of other species of *Leersia* were examined in reference to their rootstocks.

A considerable portion, if not all, the species of *Muhlenbergia* put forth flowering branches. In case of *M. debilis* Trin., some of the lower internodes from the surface to five or more centimetres above frequently branch at the nodes, where there are clusters of

[1] Edited by Prof. Charles E. Bessey, Lincoln, Neb.
[2] Read before the Botanical Club of the A. A. A. S., in New York, Aug., 1887.

bracts or short leaves. The specimens of this species examined were quite erect, not geniculate, nor rooting at the nodes.

The culms of *M. diffusa* Schreb., *M. neomexicana* Vasey, are much like those of the former species, only they are geniculate, and root freely at the nodes.

From those which are geniculate and rooting at the nodes, it is only a step to those which bear rootstocks on or below the surface of the ground.

M. comata Benth., produces branching rootstocks about five mm. long by one mm. in diameter. These are covered with thin bracts rather loosely appressed, and from one to two mm. long. They represent the sheaths of leaves only.

M. glomerata Trim., has rootstocks much like those of *M. comata*, only the internodes are a little shorter and the appressed scales more abruptly pointed. *M. willdenovii* Trin., has rootstocks which are rather larger, with internodes still shorter (1½ mm.), the scales broad, appressed, and more abruptly pointed than either of the previous species of *Muhlenbergia*.

The scales of *M. mexicana* Trim., are rather short, and bend abruptly away from the rootstock. The scales of *M. sylvatica* (T. and G.), are much like those of the former species.— *W. J. Beal, Agricultural College, Mich.*

Effect of Ice Upon Trees.— In the latter part of March of the present year a heavy fall of freezing rain covered the trees of eastern Nebraska with a coating varying from one-third to one-half an inch in thickness. Every twig, every bud was encased in a thick, transparent, icy envelope, whose weight bent and broke a great number of branches from the trees. There was a notable difference in the behavior of the different trees under this weight of ice. Trees with branches standing approximately at right angles with their axes fared best, while those with more upright branches were greatly mutilated. Thus the cottonwoods (*Populus monilifera* Aiton) suffered far less than their near relative, the Lombardy poplar (*Populus dilatata* Ait.). In the former, the widely spreading branches drooped over under the weight, and often became quite pendent, or even touched the ground without breaking, while in the last species the upright branches snapped off long before they reached a position sufficiently pendent to be stable. In the Cottonwood the branches had to bend through an arc of almost 90°, while in the Lombardy poplar the arc was increased to fully 135°. As a consequence the trees of the latter species were frequently almost entirely stripped of their branches, their stems remaining as nearly bare poles. On comparing different trees of the cottonwood, it was plain that those approaching the *excurrent* type of ramification suffered least. Some trees of this type were

PLATE IV.

Fig. 1. Rootstocks of *Leersia virginica* Willd., × about $1\frac{1}{3}$.
Fig. 2. Enlarged drawings of portions of separate rootstocks of *Leersia virginica* Willd., to show details as to the scales.
Fig. 3. Rootstocks of *Leersia oryzoides* Swartz, about $\frac{3}{5}$ natural size.
Fig. 4. *Muhlenbergia debilis* Trin., × about $1\frac{1}{3}$.
Fig. 5. *Muhlenbergia diffusa* Schreber, × about $1\frac{1}{3}$.
Fig. 6. *Muhlenbergia comata* Benth., × about $1\frac{1}{3}$.
Fig. 7. *Muhlenbergia glomerata* Trin., × about $1\frac{1}{3}$.
Fig. 8. *Muhlenbergia willdenovii* Trin., × about $1\frac{1}{3}$.
Fig. 9. *Muhlenbergia mexicana* Trin., × about $1\frac{1}{3}$.

scarcely injured at all, while those with a more *deliquescent* branching suffered the loss of nearly all their branches.

Elms usually bent their branches until supported on the ground. Maples (*Acer dasycarpum* Ehrh.) acted very nearly as the Cottonwoods did, some breaking, while others withstood the strain. No hackberries (*Celtis occidentalis* L.) broke at all, their strong branches with axillary angles of nearly 90° rendering them strong enough to withstand the heaviest weight.

White pines (*Pinus strobus* L.) suffered more than the Scotch and Austrian pines, the latter having (when young) more widely divergent branches than the former. Red Cedars and Balsam Firs trailed their lower branches upon the ground, while those above hung and rested upon those below.

An attempt was made to estimate the weight borne by each tree, and the result showed that such ice burdens are very generally overestimated. By melting the ice from a measured length of a twig, it was easy to estimate the amount of water carried by the tree. It was found that for a fine box elder, twenty-five feet in height, and with a large rounded top fully twenty-five feet in diameter, the total weight did not exceed three hundred pounds. The calculation was carefully revised, because the result seemed too small, but it was found to be correct. The effects which are so striking are clearly due to the fact that this weight, although so small, is borne as well by the slender twigs as by the larger branches. A weight of a few ounces upon the end of a long twig produces a much greater bending than many pounds would at its base.—*Charles E. Bessey.*

ZOOLOGY.

Sponges and Cœlenterates of Australia.—Dr. R. von Lendenfeld has published a résumé of the facies of the Australian Cœlenterate fauna (*Biol. Centralbl.*, Jan. 1, 1888). Australia is especially rich in sponges, containing no less than seventy per cent. of the known species of horn-sponges, Chalinas and Desmacions. Of the two first-mentioned groups, five hundred and seventy-five species and varieties have been described from all parts of the world; and of these, no less than four hundred and fourteen have been recognized in Australian waters. At least forty or fifty per cent. of the horn-sponges of any other region may be found in Australia; and this is not limited by distance or any other barrier. But the Australian horn-sponge fauna is most nearly related to those of Atlantic North America and of East Africa, the fauna of the Northern Indian Ocean differing more from that of Australia than does that of our own coast. Dr. von Lendenfeld regards the Monoxonous Tethyoid sponges as derivations of the Tetraxonia,

and says that in Australia almost all of the Tetraxonia have developed into the Tethyoid type. He does not agree with Ridley and Dendy in their views of the origin of the horn-sponges, but regards this group as having a polyphylitic origin. The Australian Calc-sponge fauna is very rich, while the deep-sea Hexactinellidæ and Lithistidæ are wanting.

His conclusions regarding the sponges are:—(1) The littoral sponges are widely distributed, about half the species being cosmopolitan; (2) The most recent and most highly-developed forms rarely occur in the colder waters, and their relative numbers is in proportion to the coldness of the sea; (3) Newer forms follow the older, not only when we go from the deeper to the more littoral zones, but from the poles to the tropics; (4) The lower and older types are more plenty in the cold than in the warmer seas, and are especially rare in Australia; (5) There are a series of forms which are confined to Australia, but there is only a few which are confined to any other region; (6) All the larger genera are cosmopolitan; (7) The fresh-water sponges are more uniform and more widely-distributed than are the marine sponges.

New England Medusæ.—Dr. J. W. Fewkes presents (*Bulletin Mus. Comp. Zool.*, xiii.) a list of the Medusæ which he has studied on the coasts of Maine and Grand Menan. The list embraces fifteen species and is illustrated by six plates. A full account is given of *Nanomia cara*, supplementing the account of Dr. Alexander Agassiz, showing that these forms really possess both sexes united in one colony, and giving an account of the embryos up to the eight-cell stage. The rare *Callinema ornata* is also figured and described. The most interesting form mentioned in the paper is a curious parasitic hydroid, for which a new genus and species (*Hydrichthys mirus*) is established, which was found at Newport, R. I. Attached to the side of a specimen of the fish *Seriola zonata* was found a colony of the hydroid, which, in captivity, gave off numbers of the medusa stage. The colony is attached to the fish by a leathery basal plate or hydrorhiza, much like that of Hydractinia. From this arise the branching, naked colony, with its numerous medusa-buds. The hydranths are without tentacles; and Dr. Fewkes thinks the hydroid a true parasite, taking its food by means of the anastomosing canals in the basal plate. Numbers of the medusæ were hatched which passed through a two-tentacled (Stomatoca) stage into one (Sarsia) with four tentacles, but it was not possible to rear them further. Dr. Fewkes compares this form with both the Tubularians and Velella. The relationship seems clearly to be with the former; and the similarities of the form to the Siphonophores are scarcely more evident than are those of any of the Hydromedusæ.

New Type of Hydroid Development.—Dr. W. K. Brooks, in the Johns Hopkins *Circular*, No. 63, describes a peculiar type of multiplication in a species of Oceania, studied in the Bahamas. Its hydroid larva is a small, abundant campanularian, which gives rise to a small medusa with eight marginal tentacles and four rudimentary radial reproductive organs. Some of these medusæ had, growing out from the reproductive organs into the cavity of the bell, true hydroid reproductive organs with chitinous cups (medusæ buds), and all exactly like those on true hydroid colonies. The blastostyles are peculiar, in that they differ from all other buds, in that this is a case of an adult budding larvæ [the abstractor adopts the views of Claus, Boehm, and Brooks as to the relationships of hydroid and medusæ], and that, while these buds have their ectoderm continuous with that of the parent, the entoderm is distinct and is seen to arise from the cells of the reproductive organs; and after these buds are formed, they are nourished at the expense of the reproductive cells of the medusæ. This type seems to be a peculiarly modified type of gemmation rather than an instance of sporogenesis, like that lately described by Metschinkoff in a species of Cunina.

Development of Brain Coral.—Mr. H. V. Wilson has studied the development of *Manicina areolata* (J. H. U. *Circular*, No. 63). The eggs are fertilized and undergo their early development in the body of the parent, beginning free life as solid planulæ, with beginning œsophageal invagination. The germ-layers are earlier formed by delamination, and now the endoderm begins to absorb the bottom of the œsophageal in-pushing and to form the permanent entoderm. The processes of formation of mesenteries and filaments is complicated, consisting in a pressing down of the entoderm and a successive application of the sides of the œsophagus to the ectoderm of the body in the various mesenterial planes. The filaments then arise as ectodermal lobes growing down along the body-wall from the inner extremity of the œsophagus. The entoderm later grows up under these, and thus arise all the mesenteries. The process of providing the incomplete mesenteries with filaments is more complex. The order of origin of the mesenteries differs from that of Lacaze Duthiers. The free life varies from a week to six or eight. They then settled down, and the basal ectoderm secreted a small calcareous plate. It was not possible to rear them beyond this point. Young polyps a quarter of an inch across had twelve septa developed; and it is noticeable that the edges of these were toothed, the teeth protruding through the external wall.

Mr. Wilson's observations go far to demonstrating the homologies between the Actinozoa and the Scyphistoma stage of Aurelia, as described by Götte.

Muscles of Molluscs.—There are frequently described in molluscs striated muscles, sometimes of a peculiar type. Müller and Keferstein have described them in the heart of Cephalopods and in the pharynx of the Cephalophora; Blanchard, in the adductors of Pecten, and Paneth, in the fins of Pteropods and Heteropoda. Schwalbe has described in the adductors of the lamellibranchs and elsewhere muscles with a double oblique striation, while, before him, Mettenheimer, Wagener and Margo had referred to the same appearance as spiral striation. Lately, Fol (*Comptes Rendus*, Jan. 23, 1888) has investigated the same subject, and concludes that true striated muscles do not exist in any mollusc. All cases reported as such, in reality, consist of smooth fibres, around which fine fibrils are rolled in a spiral manner, this being the case in all the special instances noted above. The method employed by Paneth (glycerine and nitric acid) produced such contraction that the spiral fibrillæ really appeared transverse. All of the molluscan muscles are of the smooth type; but these are to be grouped in two sub-divisions—that already mentioned, and that in which the fibrillæ are straight. The latter are the more abundant. Judging from their distribution, the spiral type are of value where a rapid contraction is needed.

The Primary Groups of Mail-cheeked Fishes.—A recent study of the structural characteristics of the mail-cheeked fishes has led to some interesting and unexpected results. The genus *Dactylopterus*, which has been almost universally closely associated in the same family with *Trigla* or *Peristedion*, and especially with the latter, was found to differ very widely. The relative proportions of the spinous and soft parts of the dorsal fin, to which so much value has been attributed by Dr. Günther, proves to be of comparatively slight importance. All the families recognized by Dr. Günther, except that of the Heterolepidotidæ, are very unnatural combinations of dissimilar groups; most of those recognized by myself are amply justified by anatomical evidence, but several others must be added to the list.

The genius of Cuvier, manifested in the perception of the relations of forms differing so much in superficial characteristics as do the mail-cheeked fishes, is justified by a detailed study of the various constituents of that group. The course of Günther and his followers in disintegrating it, widely divorcing its constituents, and associating its fragments with dissimilar forms, was a decidedly retrograde step. Nevertheless, although the group is one whose members are genetically connected, the diversities of structure are too great to allow of their retention in one family or even superfamily. They must be distributed into four (and ultimately more) superfamilies; those now determined are the Scorpænoidea, the Cottoidea, the Trigloidea, and the Dactylopteroidea. Several forms

that have not yet been anatomically investigated represent families—Caracanthidæ, Platycephalidæ, Agonidæ, and Rhamphocottidæ—exhibiting very peculiar characters, which must be reflected in their skeleton, and their exact relations remain to be ascertained; probably none belong to any of the superfamilies now established.[1]

The families hereinafter enumerated appear to be all well entitled to the rank, and are characterized by various anatomical peculiarities. The most closely allied pair, and which perhaps need future confirmation, are the Hexagrammidæ and Anoplopomidæ. All the families will be diagnosed and, in part, fully described in several memoirs prepared for publication in the Proceedings of the United States National Museum, and the anatomical characteristics of the crania will therein be illustrated. The comparative characteristics of the major groups, or superfamilies, are made known in the following analytical exhibit:

A. Scapular arch normal, the post-temporal and postero-temporal forming part, and the latter intervening between the post-temporal and the proscapula. Infraorbital chain with all bones entering into the orbital margin and functional, only partially extended over the cheek; with the third bone hypertrophied and developed as a stay impinging on the anterior wall of the preoperculum; post-temporal normally articulated with the epiotic and pterotic; intermaxillines with well-developed ascending pedicles gliding over the front of the prosethmoid.

1. Dentigerous epipharyngeals 3.3; actinosts moderate and inserted on posterior edges of hypercoracoid and hypocoracoid; ribs backwards borne on enlarged parapophyses.—*Scorpænoidea.*

2 Dentigerous epipharyngeals 1-1; actinosts large and partly intervening between the hypercoracoid and hypocoracoid; ribs sessile on the vertebræ.—*Cottoidea.*

B. Scapular arch abnormal, the post-temporal forming an integral part of the cranium and the postero-temporal crowded out of place by the side of the proscapula above or at the edge of the post-temporal.

1. Myodome (muscular tube) developed and cranial cavity open in front; prosethmoid and anteal normally connected by suture. Infraorbital chain with its anterior bones excluded from the orbit and functional as rostrolateral, the series covering the cheeks, the third a large buccal bone articulating with the anterior wall

[1] An examination of the *Platycephalidæ*, *Agonidæ* and *Rhamphocottidæ*, since the preparation of this note, has confirmed my suspicion that they are severally types of distinct superfamilies, *Platycephaloidea* (with families *Platycephalidæ* and *Hoplichthyidæ*), *Agonoidea*, and *Rhamphocottoidea.* I have been unable to secure specimens of *Caracanthidæ*, and know nothing of their anatomy.

of the preoperculum; post-temporal suturally connected with the epiotic and pterotic by inferior processes, and with the upper surface forming an integral part of the roof of the cranium; intermaxillines with the ascending pedicles atrophied and connected with the knob of the anteal (vomer) by ligament.—*Trigloidea.*

2. Myodome undeveloped, the cranial cavity being closed in front by expansions from the subtectals suturally connected with corresponding expansions of the prootics and the parasphenoid; prosethmoid and anteal entirely disconnected, leaving a capacious rostral chamber opening backwards mesially into the interorbital region. Infraorbital chain, with its second and third bones crowded out of the orbital margin by junction of the first and fourth, and leaving a wide interval between the suborbitals and the preoperculum; the first very long and extending backwards, the second under the fourth and the third developed as a small special bone (pontinal) bridging the interval between the second suborbital and the antero-inferior angle of the preoperculum; post-temporal suturally connected with the posterior bones of the cranium, and with the upper surface forming a large part of the roof of the cranium; intermaxillines with well-developed ascending pedicles gliding into the cavity between the anteal (vomer) and prosethmoid.—*Dactylopteroidea.*

The superfamily SCORPÆNOIDEA includes the families Scorpænidæ, Synanceidæ, Hexagrammidæ, (or Chiridæ), and Anoplopomidæ. The Caracanthidæ are generally associated with the Scorpænidæ and may belong to the superfamily, but this is doubtful.

The superfamily COTTOIDEA embraces the families Hemitripteridæ and Cottidæ.

The superfamily TRIGLOIDEA includes the families Triglidæ and Peristediidæ.

The superfamily DACTYLOPTEROIDEA is represented only by the family Dactylopteridæ.

It is probable that the Trigloidea and Dactylopteroidea will be hereafter segregated as representative of a peculiar suborder.—*Theo. Gill.*

THE COCOON OF PROTOPTERUS.—Professor Wiedersheim (Anat. Anzeiger) has collected together the various notices that have been written by J. E. Gray, A. D. Bartlett, Krauss, A. Günther, and others concerning the structure of the case or "cocoon" of the curious fish Protopterus, and describes the result of his own observations upon the subject. Krauss's description of the membrane surrounding the fish is substantially correct. It appears to be designed to protect the animal from damage during its æstivation;

but the source of the secretion composing it—whether the skin or a special apparatus—is not yet known. The manner in which the animal lies rolled up within its case is very singular and has not previously been described. The head and anterior part of the body are concealed or roofed over by the broad membrane of the lower lobe of the tail. Our author thinks it probable that the broad tail-fin serves the Protopterus for a purpose unheard of before, viz., as a breathing organ. The part which covers the head has a reddish tint, and it seems likely that it is permeable to air, even if we suppose it is in communication with the breathing-tube piercing the capsule.

A Grain-Eating Reptile.—Several lizards have been known to eat vegetable substances, among them *Uromastix acanthinus*, *Eumeces aldrovandi*, *Lacerta ocellata* and *Stellio vulgaris*. Johann von Fischer calls attention to the fact that *Uromastix hardwickii*, a Bengalese species in his possession, would take no animal food; but an examination of his excrement disclosed an abundance of starch granules. This led him to place before him various grains—rice, corn, etc.—which he ate with avidity. This is a new feature in reptilian diet. He also afterward ate various insects and drank—a fact which has not been witnessed in its relative, *U. acanthinus*. The chief food of the latter, lettuce, was neglected by the species in question, but it willingly ate straw and hay.

The Occurrence in Indiana of the Star-nosed Mole (*Condylura cristata* L.).—The star-nosed mole is rather generally distributed over northeastern North America. It is, apparently, common from Nova Scotia to New York and Pennsylvania, and Dr. C. Hart Merriam reports it as a "common animal along the outskirts of the Adirondacks, where it manifests a predilection for moist situations, being usually found in low ground and in the neighborhood of streams." West of New York and Pennsylvania, specimens had been taken by Dr. J. P. Kirtland at Cleveland, Ohio, and by Dr. J. F. Head at Fort Ripley, Minnesota, but only one specimen in the first and two in the second named State. In the Mississippi Valley, therefore, this interesting and curious mole would seem to be very rare. It therefore gives me pleasure to be able to report the capture of a specimen in this State. About the 5th of July last a fine adult male was obtained by Mr. J. C. Cunningham, near Denver, Miama county, Indiana. It was found lying dead near his door-step, where it had been dropped by the family cat, to whom belongs the honor of its capture. The specimen is now in my possession, through the kindness of Mr. Cunningham. This, so far as I know, is the first record of its capture in Indiana.—*B. W. Evermann*, Ind. State Normal School, Terre Haute, Ind.

Zoological News.—Echinoderms.—The habitat of the star-fish, *Echinaster decanus* Müller und Troschel, has not been known. Lately it has been dredged of Port Jackson, Australia. Professor F. Jeffrey Bell, in an account of the specimens, states that the species is remarkable for the large size of the pore areas, in which there are a large number of respiratory processes, and hence concludes that it lives in situations where respiration under ordinary circumstances would be difficult.

The brothers Sarasin have a note on the longitudinal muscles and "Stewart's organs" in the Echinothuridæ, in the *Zool. Anzeiger*, No. 273. The long muscles are of use in the vermicular movements of Asthenosoma. Concerning the function of "Stewart's organs," they have no opinion to offer.

Fifty species of Echinoderms, twenty-two Holothurians, thirteen Asteroids, six Ophiuroids, and nine Echini, have been collected at the Andaman Islands by Mr. Booley.

Worms.—Mr. F. E. Beddard continues his notes on the earth-worms. In the *Zool. Anzeiger*, No. 272, he states that the "mucous gland" described by Perrier in Urochæta "consists of a tube opening on to the exterior by a single orifice and branching distally into a number of tubules, each of which opens into the cœlom by a ciliated funnel," these funnels being disposed irregularly, and not metamerically.

In another note in the same number he describes briefly the salivary glands and capsulogenous glands in Perichæta. The former he regards as homologous of the septal glands of other Oligochætes. The capsulogenous glands, it is hoped, will furnish good characters for the discrimination of the species of this difficult genus.

Dr. Frederick Tuckermann notes a specimen of *Tænia saginata* of unusual size. Only a portion of the worm was obtained, but this consisted of 711 segments, and measured 7.455 metres in length. Comparison with other specimens led to an estimate that the whole worm consisted of about 1060 joints, and a total length of 7.655 metres.

According to Mr. R. Moniez, the cysticercus of the Tenebrios does not belong to *Tænia nana*, but, as is proved by the length and the number of its hooks, to *Tænia microstoma*, a species parasitic within the mouse. *T. nana* and *T. murina* constitute two distinct species, and the latter develops in the intestine of the rat without an intermediate host.

Arachnida.—Duges describes (*Bull. Soc. Zool. France*, 1888) a new species of mite, *Geckobia oblonga*, which occurs, parasitic, upon the lizard, *Scoleporus spinosus*. The species is noticeable for the elongate organs, of problematical functions, which arise on either side above the base of the rostrum. They have an appendicular

appearance, are united at their bases, and terminate, each, in a toothed pincer.

Fishes.—M. L. Vaillant has recently, in a note upon the comparative dimensions of young and adult examples of *Alopias vulpes*, remarked that the size of the young is, among fishes, influenced by that of the parent, which commences to reproduce before its growth is complete. A specimen of *A. vulpes*, taken at Cette, measured 4.70 metres in length, and the largest of four fœtuses contained within its oviduct had a length of 1½ metres. On the other hand, a female fox-shark, 1.17 metres long, also contained fœtuses.

It is not always that collectors note down the colors of the specimens while still alive, and thus the small collection of fishes from the Society Islands and Paumotu, made by Lieut. M. Trigon, becomes of value through the sketches accompanying it. M. Vaillant draws attention, in some prefatory remarks, to the losses incurred by attaching metal tags to the specimens by means of copper or iron wire instead of by vegetable fibre. Galvanic action is set up, and the scales and bones of the fishes, as well as the wire itself, are destroyed or fall apart.

A recent number of the *Izvestia*, of the Russian Geographical Society, contains M. Nicolsky's sketch of the fishing on Lake Aral, which is a valuable contribution to the ichthyology of that lake and of the Lower Arnu-daria.

After two periods of three years, each separated by one year of abundance (1883), sardines have returned to the French coast in greater abundance than ever, precisely at the period when the Government was commencing to inquire into the scarcity of that valuable little fish. M. Pouchet gave, in the *Revue Scientifique*, (June 11, 1887), reasons why 1887 might be expected to be a good year. Investigation of the ovaries of sardines of various sizes has convinced M. Pouchet that the sardine spawns at any season of the year, but always far from the coast, in other latitudes, or in inaccessible depths. The youngest sardines which visit the French coast are three or four months old, while those which are preserved in oil are about one year old and have not yet spawned. The sardine first spawns in the second year of its life.

Mr. and Mrs. C. H. Eigenmann catalogue the American species of Gobiidæ and Callionymidæ in the *Proceedings California Academy*, 1888. They enumerate seventy species belonging to the first, and four to the second, family. The new species are: *Gobius lucretiæ*, *G. garmani*, *G. hemigymnus*, *Microgobius eulepis*, *Barbulifer* (n. g.) *papillosus*, and *Callionymus calliurus*. A new genus, Clevelandia, is made for *Gobiosoma longipinnis*.

G. B. Howe (*P. Z. S.*, London, 1887), discusses the skeleton of the paired fins of Ceratodus, with observations upon those of the Elasmobranchs. His conclusions are that the characters of the

skeleton of the paired fins are inconstant, some of those of the praxial parameres of the pectorals and the basal mesomere of pectorals and pelvic fins; that a reduced metapterygrum is always present in the pectorals, and may occasionally be traced in the ventrals; and that the basal mesomere of the Ceratodus fin may conceivably have been derived from the metapterygium. The structural features of both paired fins of the Chimæroids are identical, and characterized by the absence of a mesopterygium, and the paired fins of Plagiostomes and Dipnoans have probably arisen from a type of fin most nearly represented by that of the living Chimæroids.

Prof. T. J. Parker describes and figures, in the Proceedings of the Zoological Society of London, the skeleton, fins, heart, brain, etc., of *Carcharodon rondeletii*, from specimens taken near Dunedin, New Zealand. A peculiarity in external form, scarcely noticed previously, is the depression of the tail just in front of the caudal fin, so much so that the width is more than double the height. Prof. Parker believes that this flattening, present also in Lamna, gives a combination of horizontal with vertical tail-fin, useful as a means of enabling the fish to rise rapidly from great depths.

Mr. Francis Day has lately published a work on British and Irish Salmonidæ. He regards the different forms of non-migratory trout known as Brook trout, Lochleven trout, Crasspuill trout, Estuary trout, Orkney trout, Cornish trout, Great Lake trout, Gillaroo trout, and Swaledale trout, as varieties of one species, and all the species of char as identical with *Salmo salvelinus*.

Reptiles.—Mr. C. M. Woodford has recently returned from the Solomon Islands with a collection of over two hundred reptiles, which have been examined by Mr. G. A. Boulenger. The fact that this large collection contained but four new forms indicates that the reptilian fauna of these islands is pretty well known.

Mr. F. E. Beddard notes the presence of a peritoneal fold in the genus Monitor, separating the lungs from the abdominal viscera, and corresponding to a similar structure in the Crocodilia.

Mr. G. A. Boulenger describes a Leptodactylus, three species of Lygosoma, *Typhlops aluensis*, and the Batrachia *Hyla lutea* and *Batrachylodes vertebralis*, from a collection made in the Solomon Islands by Mr. C. M. Woodford.

Two lizards, *Varanus niloticus* and *Chameleon owenii*, and the snakes *Naia haje* and *Dendraspis angusticeps*, were collected by Mr. Johnston, at a height of 2000 feet on the Cameroons Mountains.

M. L. Vaillant (Bull. d. l. Soc. Philo. de Paris) has recently described a new species of land-tortoise (*Testulo yniphora*) from one of the Comoro Isles, or from an islet in their vicinity. The carapace of the largest specimen is about fifteen and a half inches long,

twelve and a half inches wide, and nearly a foot in height. There is a small nuchal plate, and the plastron terminates anteriorly in a long, upturned tapering projection.

Birds.—Mr. D. D. Daly, at a recent meeting of the Zoological Society of London, gave an account of the caves in Borneo, from which the edible birds' nests are obtained. Of these, fifteen are known in North Borneo. Most of these are in limestone in the interior, but two are near the coast, and occur in sandstone strata.

Mr. H. N. Ridley found a new species of tyrant-bird in his explorations of the island of Fernando Norohna. Mr. R. Bowlder Sharpe has described it, under the name *Elainea ridleyana.*

Mr. R. S. Wray has found in the wing of the adult ostrich a vestigial structure representing the distal phalanges of digit III. (*P. Z. S.*, 1887.)

Among the thirty-five species of birds collected by Mr. C. Woodford, in the Solomon Isles, is a new crow, described by Mr. Ogilvie Grant as *Macrocorax woodfordi.*

Mr. Bowdler Sharpe has described (*P. Z. S.*, 1887) seven new species of birds, from a collection made by Mr. L. Wray in the mountains of Perak, in the Malay Peninsula.

Mr. R. S. Wray contributes to the *Proceedings* of the Zoological Society of London (1887), an important paper upon the morphology of the wings of birds.

Mammalia.—Dr. Dubois describes a sixth species of Anomalurus, under the name *A. chrysophœnus*, in the *Bulletin Société Zoologique* for January. It is most nearly allied to *A. pelii* of Temminck, and comes from West Africa.

The collection of mammals recently made in the Solomon Islands by Mr. Woodford, consisted chiefly of bats. Nothing was before known of the cheiropterous fauna of these islands. The new forms are *Pteropus gradis* and *Nesanycteris woodfordi*, nov. gen. et sp. The length of the head and body of a skin of *P. gradis* was 325 m. m., of which the head measured seventy-four m. m.

ENTOMOLOGY.[1]

On the Synonymy of the Apple-Leaf Creaser, Ornix geminatella (Packard).—Having lately had occasion to study the Tineidæ infesting apple leaves in Illinois, I have been puzzled over the proper name of a common species which inhabits a tent-shaped mine on the under leaf-surface. It is the insect that Mr. A. E. Brunn has discussed[2] as *Ornix prunivorella* Chambers, but which I believe to be the same as Packard's *Lithocolletis geminatella.* The agreement of my specimens of the various stages of the insect, with the descriptions of these species as given by Packard, Chambers and Brunn, led to a careful examination of the literature treating of the two species, the results of which I briefly summarize below. The subject is more fully discussed in a paper to be published in the Fifteenth Report of the State Entomologist of Illinois.

The various stages of *Lithocolletis geminatella* were described and figured by Dr. Packard in 1869.[3] The description of the moth is rather brief, but the figure is excellent. The larva is said to be of a pale livid reddish color, with the head and cervical shield black; and to mine the leaves of apple and pear.

Two years later Chambers published[4] an article on the described species of Lithocolletis, in which he surmises that geminatella does not properly belong to this genus.

In the *Canadian Entomologist* for March, 1873, Mr. Chambers published a description of *Ornix prunivorella,* stating that the larva mines the leaves of the apple and wild cherry, and giving a brief account of its habits.

In an article on the Food-plants of the Tineina, published somewhat later,[5] Mr. Chambers mentions this species as feeding on wild cherry, but strangely enough omits it from the list of those feeding upon apple, although in connection with the original description he remarks that "the larva mines the leaves of apple trees." In this list *Lithocolletis geminatella* is not mentioned.

In 1882 Lord Walsingham published[6] some "Notes on the Tineidæ of North America." This paper was the result of a study

[1] This department is edited by Prof. J. H. Comstock, Cornell University, Ithaca, N. Y., to whom communications, books for notice, etc., should be sent.

[2] Tineidæ Infesting Apple Trees at Ithaca. Sec'd Rept. Corn. Univ., Exp. Stat., p. 157.

[3] Guide to Study of Insects, p. 353; Plate viii., Fig. 15.

[4] Can. Ent., vol. iii., p. 133.

[5] Bull. U. S. Geol. Surv., vol. iii., p. 133.

[6] Trans. Am. Ent. Soc., vol. x., p. 194.

of several American collections of these moths, many of the specimens being types of American species. On page 194, in speaking of certain of these specimens, he says:—

"I think these may be *Ornix prunivorella* Chamb., although that author does not record that the larva of that species feeds on apple or pear. These specimens are not in good condition, and it is impossible in so difficult a genus as *Ornix* to be quite certain to what species they belong.

"They are the types of *Lithocolletis geminatella* Packard, according to the label attached to the second specimen, but they undoubtedly belong to the genus *Ornix*."

From the statement just quoted, that Chambers does not record the apple-feeding habits of *O. prunivorella* it seems evident that Lord Walsingham had been misled by the omission in the list of food-plants noted above.

As the leaves of this species are quite characteristic, I sent specimens to Dr. Packard with the request that he examine them to see if they were similar to the ones from which he bred *L. geminatella*. In reply he says: "I have examined the *Ornix prunivorella*—two larvæ—white, exactly of the size and shape of my geminatella, which I have not seen for nearly twenty years. Mine was a uniformly brown caterpillar, but the spots on prothoracic segment were not so distinct as appears in your specimen—yet in my figure I see they are represented. I suppose the alcohol brings out the tubercles more distinctly than in life. It may be safe to regard the two species as identical, since Chambers bred it from the apple. On turning to Emerton's original drawing I see the spots on the thorax are represented just as in your specimen. My description on the sketch says: 'Color pale livid reddish, suspended by a thread to the tree.' On the whole, then, I conclude that the larvæ you send are those I described as *L. geminatella*."

The difference in the colors of these larvæ may easily be accounted for on the supposition that Dr. Packard's specimen was immature, for, as Mr. Brunn has remarked, these larvæ are flesh-colored when young.

In the light of these observations I believe that I am justified in treating these supposed species as the same, and, as Dr. Packard's name has priority, in calling the insect *Ornix geminatella* (Pack.).—*Clarence M. Weed.*

Contagious Diseases of Insects. — Professor Forbes, in his address as retiring president of the Cambridge Entomological Club,[1] discusses the present state of our knowledge concerning contagious insect diseases. The address contains a statement of so many facts that it is not possible to abstract it in a short space. It should be read by all interested in the biological side of entomology that

[1] Psyche, Vol. V., pp. 3–12.

have not occasion to keep track of the literature concerning the minute organisms that cause disease. A few of the more general points can be stated here. Contagious disease, wherever it has been traced to its origin, has proved to be the phenomenon of parasitism. This address is limited to a discussion of epidemics caused by Fungus or Protozoan parasites.

Of the Protozoan diseases of insects, *pebrin* of the silkworm is the best known example. There has been much discussion regarding the position of this parasite; but there can be no longer a reasonable doubt of its animal nature, or of its agreement in general characters with those forms now commonly included under the head *Sporozoa*, a parasitic subdivision of the Protozoa of which *Gregarina* is perhaps the best known type. The life history of this parasite is very simple, and may be thus briefly summarized.

The minute oval spores, colorless, highly refractile, homogeneous in appearance, 4 μ long by 2 μ wide, when swallowed with the food, penetrate in some way unexplained the cuticle of the alimentary canal, and, in the cells of the epithelium, open at one end and emit their contents, each in the form of an amœboid speck of protoplasm. This grows to a spherical body, and, by a process of internal segmentation common to the Sporozoa, is soon converted into a mass of spores, each like the original. These spores everywhere undergo a like development, and load all of the tissues with their products, slowly and gradually arresting all of the functions of life. Their vitality is temporary — Pasteur's experiments showing that they will not germinate five weeks after drying out — and the disease is consequently maintained only by virtue of its hereditary character.

Other forms of Microsporidia have been found in at least ten species of insects enumerated by Forbes.

Although pebrine, and presumably other diseases of this nature, can be conveyed to healthy insects by treating their food with the dejections of affected individuals, the economic application of these diseases is limited to artificial measures for developing and accelerating them wherever they may be found, and to the transfer of them from one species to another. For there is not the slightest probability that the Sporozoa can be artificially cultivated outside of the bodies of the animals that they infest.

The notable fungous diseases of insects are readily divisable into two principal groups: *Schizomycoses*, produced by Bacteria, and *Hyphomycoses*, due to Fungi that form a more or less evident mycelium of cylindrical threads (*Hyphomycetes and Pyrenomycetes*). These are roughly distinguishable in two important particulars: (1) The bacteria invade the body from within, by way of the alimentary canal; and the thread fungi penetrate from without through the skin or spiracles; (2) Death from a schizomycosis is followed by rapid decay, which soon reduces the tissues to a putrid

fluid; while after death from a hyphomycosis the often flaccid body hardens and mummifies without decay, usually swelling to more than its usual size, and frequently becoming covered with a flour-like efflorescence of spores or spore-like bodies.

These last characters distinguish the hyphomycoses from the *pébrine*, — the body mummifying in the latter, but shriveling at the same time and never covering itself with spores, unless with those of a common mould of *post mortem* development. Further, the *pébrine* mummy contains only the minute oval spores of the parasite, while that of a hyphomycosis contains either a mass of mycelial threads or large thick-walled, spherical spores, — the lasting spores of the *Entomophthora*, or, possibly, both spores and mycelium together.

Examples of Schizomycoses, diseases produced by bacteria, are *flacherie* of the silkworm and foul brood of bee larvæ. Among the hypomycoses are muscardine and the common house-fly fungus, *Empusa muscæ*. In fact, nine-tenths of the adult and larval insects found dead and stiff on fences, weeds, grass, etc., in ordinary collecting, are victims of these parasites.

The Progenitors of Myriapods and Insects. — Under this title Professor B. Grassi[1] discusses the classification of the Thysanura, describes several new species of *Lepisma*, gives an account of the anatomy of *Lepisma* and *Lepismina*, and discusses the musculature of Thysanura. The last topic is of especial interest at this time as bearing on the separation, proposed by Brauer, of insects into two groups of equivalent rank, the Apterygogenea and the Pterygogenea, the former group containing only the Thysanura, the latter, all other insects. Professor Grassi was unable to discover in the musculature of Thysanura any indication of the previous existence of wings, thus confirming Brauer's view that these insects were "originally wingless," instead of, as in the case of wingless forms in the higher orders, being descended from winged ancestors.

The longest article contained in the *Proceedings* of the Zoological Society of London, Part II., 1887, is by Mr. E. B. Poulton, and treats of the protective value of color and markings in insects. It contains the tabulated results of extensive experimental researches.

[1] Bull. Soc. Entomol. Ital. XIX. (1887), pp. 52–74.

EMBRYOLOGY.[1]

Rudiments of True Calcified Teeth in the Young of Ornithorhynchus.[2]—Mr. E. B. Poulton, in a brief communication to the Royal Society, announces the discovery of the germs of true calcified teeth in the young of the Duck-bill, of 8.3 centimetres in length. The sections had been prepared by Professor W. N. Parker for Dr. W. K. Parker, who very generously placed them at the disposal of Mr. Poulton, and also urged the latter to publish the account of his discovery, offering, in addition, still other materials, not only of Ornithorhynchus, but also of Echidna. Dr. Parker had laid the sections in question aside for a time (owing to the pressure of other work), to eventually make use of them for the purpose of studying the skull, when Mr. Poulton borrowed the preparations for the purpose of continuing his studies on epidermic structures—with the result announced; and under the circumstances his association with this discovery is, therefore, purely accidental;—yet every true naturalist will appreciate the rare generosity of spirit which Dr. Parker has shown in allowing the independent publication of the results.

Tooth-germs, or, rather, young not-yet-erupted teeth, were found in both jaws; and they were found in such a position as to indicate that they probably represent some part of the molar series in the higher mammals. Examining the sections from the front backwards, the first tooth appeared a little behind the anterior margin of the epithelial elevation, which seems to represent the developing horny plate, which, in the adult, is the functional representative of true calcified teeth. The teeth seem to form a tolerably straight line, extending internally to the horny plates, and passing considerably further backwards than the latter. Owing to imperfections in this part of some of the sections, the author could not determine the exact number of teeth with accuracy; but they appear to be five or six in number on each side. The most anterior tooth-germ is different in character from the others, and is apparently separated from them by an interval which is longer than in other cases. This anterior tooth is the most developed, and its apex extends so far towards the surface of the oral mucous membrane that it nearly touches the epithelium. It is a pointed cylindrical tooth, directed vertically downwards. The four or five posterior teeth are of uniform shape.

The structure of the enamel-cap is entirely normal, except that capillaries are present in the middle membrane (reticulum), intruding from without. The inner layer of long enamel-cells is very

[1] Edited by Prof. Jno. A. Ryder, University of Penna., Philadelphia.
[2] Proc. Royal Society. Vol. XLIII, 1888, No. 263, pp. 353–356.

distinct. No enamel is formed from them at this stage, except, probably, in the case of the most anterior tooth. The dentine-germ was found quite normal in appearance; the depressed, superiorly conical pulp-mass resembles that seen in other Mammalia, and, as in some other forms, this is to some extent embraced around the sides and below by the in-curved lower edges of the dome-shaped enamel organ, which, as in other forms, is superimposed upon the pulp. Dentinal tubules and odontoblasts can be made out in the vicinity of the apex of the pulp-mass.

There can be little doubt that these structures are characteristic mammalian teeth, as supposed by their discoverer. Hertwig's researches serve to show that mammalian teeth are probably in a more ancestral condition than any other organ possessed by the adult. They must have been derived at one time from Prototherian ancestors—and yet existing Prototheria were not known to possess them. Their occurrence in Ornithorhynchus, therefore, supplies the step just where it is wanted; and the fact that they are practically identical with the young teeth of higher mammals is a further indication of the ancestral nature of these structures; for other higher mammalian features represented in the Prototheria are profoundly modified in the latter.

Mr. Poulton, in conclusion, announces his intention of tracing the further fate of the teeth of Ornithorhynchus in later stages, for which purpose Dr. Parker has also placed additional materials at his disposal.

THE ECTOBLASTIC ORIGIN OF THE WOLFFIAN DUCT IN CHELONIA.[1]—In a note with the above title, K. Mitsukuri, of Tokio, Japan, gives a short account of his researches upon the development of the segmental ducts of *Trionyx japonica* (Schleg.) and *Emys japonica* (Gray). The author has found stages which show that the Wolffian duct arises from cells proliferated from the ectoblast, just opposite the region of the intermediate cell-mass. As described by others in other forms, these ducts in Chelonians are found by Mitsukuri to develop from before backwards.

ORIGIN OF THE WOLFFIAN DUCT IN LACERTILIANS.—Investigations upon the development of *Lacerta agilis, L. muralis,* and *L. viridis* by J. von Perenyi[2] confirms and extends his observations upon the ectoblastic origin of the segmental ducts in this and other forms. Interesting observations are also recorded by Perenyi in the above-cited note on the development of the amnion and allantois of Lacerta.

[1] Zoolog. Anzeiger, XI, 1888, No. 273, p. 111.
[2] Zoolog. Anzeiger, XI, 1888, No. 274, pp. 138–141.

THE ORIGIN OF THE MAMMÆ.[1]—In this note, W. Haacke figures and describes the temporary marsupium of Echidna, and reasserts his claim to the priority of the discovery of the oviparity of the Monotremata. The conclusion is reached that the glands subserving a mammary function in these creatures are developed from sudoriparous glands, while in other mammals the mammary organs have been developed from sebaceous glands. Two apparently carefully-drawn figures of this pouch are given, which disappears after the single ovum is hatched. This pouch is not to be confounded with that described by Gegenbaur and Owen as occurring in this animal.

PHYSIOLOGY.[2]

DOES THE VOLUME OF A MUSCLE CHANGE DURING ITS CONTRACTION?—It has long been a disputed point whether or not the bulk of a muscle alters during its contraction. As far back as the middle of the seventeenth century it was the subject of investigation by Glisson, Borelli, Swammerdam and others, but their methods allowed of errors so great as to make their results nearly worthless. The first to observe by a fairly trustworthy method that the volume of a muscle is slightly lessened during contraction was Erman, about 1812.

Erman's method consisted in placing the muscle in a cylinder filled with water, and, during contraction of the muscle, observing the level of the water in a narrow capillary tube connected with the vessel. With every stimulation of the muscle Erman noted a slight fall of the fluid in the capillary. Some time after this, Johannes Müller suggested that the sinking of the level observed by Erman was caused, not by the diminution in bulk of the muscle itself, but by the compression of the air in the spaces between the fibres. Erman's experiments were thereupon repeated by Marchand and Ed. Weber who eliminated this possible source of error by killing the animals under water. Nevertheless they still observed a fall of the water in the capillary, precisely as Erman had done before them.

In more recent times Kühne has reinvestigated the question, and employed a new method, dependent on the change in specific gravity which must result from any change in volume. By this method Kühne reached negative conclusions, for he could observe no sinking of the araometer when the muscle attached to it was thrown into tetanus.

[1] Biolog. Centralblatt, VIII, No. 1, 1888, pp. 8–16.

[2] This Department is edited by Prof. Wm. T. Sedgwick, Mass. Inst. of Technology, Boston, to whom communications, books for review etc., should be sent.

On the other hand, Valentin, by the use of the balance, observed an increase in weight of about $\frac{1}{1370}$ during tetanus.

Other observers have obtained results quite as contradictory, and it seems almost as if every investigator came to conclusions differing from those reached by his immediate predecessors. All the while, however, the balance of evidence has appeared to be on the side of those who claimed that there was a slight decrease in the volume of the contracting muscle. Most of the recent text-books state it as probable that there is this minute diminution in volume.

There has recently been published an important paper on the subject by Professor J. R. Ewald,[1] who has repeated, as closely as possible, the experiments of Erman, Marchand, Weber and Valentin. Ewald regards Erman's method as by far the most delicate, if conducted in the right way and under favorable conditions. He then suggests that Erman and his successors have erred in some critical respects in the course of their experimental work.

Ewald accordingly altered Erman's method in the following manner: Into a glass flask two platinum wires are melted just above the base, so that they are diametrically opposite, and reach some millimetres down into the vessel. On the outside they form small hooks upon which can be hung the wires leading to an induction machine. The glass stopper of the flask is hollow and ends in a tube which is drawn out so as to be capillary.

The animal is killed under water, and the muscle without the nerve freed from the body. The flask, stopper and capillary tube are then filled with water, the muscle being first dropped to the bottom of the flask, where it rests on the two electrodes. The water in the capillary tube is lowered to a level favorable for observation, and a microscope fitted with a micrometer ocular is placed in a horizontal position, in order to observe the meniscus in the capillary. The time necessary for the adjustment of apparatus, etc., takes about three minutes, from the death of the frog to the pressing of the button for the stimulation of the muscle. Ewald then declares with emphasis: "*In none of the numerous experiments performed could I detect the slightest wavering of the level.*"

Ewald gives some striking examples of the sensitiveness of this method. If the palm of the hand is brought near the tube while the level is being observed through the microscope the water is seen to sink with great swiftness, owing to the expansion of the glass. A drop of ether evaporated on the glass produces the reverse effect —the meniscus rapidly rises. If the strength of the current be increased so that bubbles of gas begin to be formed on the electrodes, it will then be seen whether a very slight increase of volume in the interior of the flask will perceptibly change the posi-

[1] Archiv (Pflüger's) für die gesammte Physiologie (1887), Bd. xli., S. 215.

tion of the meniscus in the capillary. Ewald did this, and with a duration of the current so short that the bubbles on the electrodes became just visible, he saw the meniscus bound across the whole field of vision. By calculations based on the bore of the capillary and the magnifying power of the microscope, he found that a loss of a ten-thousandth of a cubic millimeter could not have escaped notice.

The author used also a second method, somewhat similar to that employed by Kühne, and obtained the same decisive negative result. He next repeated the experiments of Valentin, which were based on the use of a very delicate balance. Here, too, he states that, with proper precautions for securing the accuracy of the apparatus, there is in no case the slightest movement of the pointer.

Ewald then gives an extended account of his repetition of the experiments of Erman, Marchand and Weber. He suggests a very probable source of error in the failure of those observers to fix the stopper firmly into the vessel used in the experiments. When this and other details were attended to, he found that he could detect with the microscope no change in the level of the meniscus in the capillary tube.

Ewald, then, has repeated the experiments of preceding observers, has devised several new methods of greater delicacy than any heretofore used, and has arrived always at the same conclusion—*that in no case does a muscle change in volume during contraction.* Moreover, he has shown in addition that there exist very probable sources of error in the methods used by those investigators who have obtained positive results. Under such circumstances we can hardly refrain from considering the question as settled beyond reasonable doubt.—*E. O. Jordan* (*Boston*).

Organization of the American Physiological Society—On the 30th of December last, about a score of the leading physiologists of the country met by appointment at the new College of Physicians and Surgeons in New York City, and proceeded to form an American physiological society. Dr. S. Weir Mitchell, of Philadelphia, was chosen temporary chairman, and Professor H. P. Bowditch, of Boston, clerk. A constitution was adopted and a formal meeting, the first of the American Physiological Society, followed. Officers were chosen as follows: *President*, H. P. Bowditch; *Secretary and Treasurer*, H. N. Martin, of Baltimore. These officers, together with Professors J. G. Curtis of New York, H. C. Wood of Philadelphia, and H. Sewall of Ann Arbor constitute the "Council" of the society. The constitution affirms that the society "is instituted to promote the advance of physiology, and to facilitate personal intercourse between American physiologists." The regular annual meetings are to be held, during the winter holidays,

at places fixed by the Council; and any resident of North America otherwise eligible (as described beyond) may be elected an Ordinary member. There were present, in fact, representatives from places as far apart as Montreal, Ann Arbor, Baltimore and Boston. The Institutions represented at the meeting included Harvard University, Yale University, Johns Hopkins University, The University of Pennsylvania, The University of Michigan, McGill University, The (Columbia) College of Physicians and Surgeons of New York, the Massachusetts Institute of Technology and the Medical Staff of the U. S. Navy.

The present members of the society are as follows: H. G. Beyer, U. S. Navy; H. P. Bowditch, Harvard University; H. C. Chapman, Philadelphia; R. H. Chittenden, Yale University; J. G. Curtis, New York; J. C. Dalton, New York; H. H. Donaldson, Baltimore; F. W. Ellis, Springfield, Mass.; G. L. Goodale, Harvard University; G. Stanley Hall, Baltimore; H. H. Hare, Philadelphia; W. H. Howell, Baltimore; Joseph Jastrow, Baltimore; W. P. Lombard, New York; H. N. Martin, Johns Hopkins University; T. W. Mills, Montreal; C. S. Minot, Harvard University; S. Weir Mitchell, Philadelphia; William Osler, Philadelphia; Isaac Ott, Easton, Pa.; E. T. Reichert, Philadelphia; W. T. Sedgwick, Boston; H. Sewall, Ann Arbor; R. Meade Smith, Philadelphia; V. C. Vaughan, Ann Arbor; J. W. Warren, Boston; William Welch, Baltimore; H. C. Wood, Philadelphia.

A Practical Definition of a Physiologist.—In the formation of any society it speedily becomes necessary to define its object and the qualifications requisite for membership in it. In the case of the new Physiological Society a general line of fitness was drawn (very wisely, as we believe) at investigation of some sort, as follows:—

"Any person who has conducted and published an original research . . . shall be eligible," etc.

Again, for practical purposes, "physiology" had to be defined; and it is very interesting to see that the physiology of to-day has so far advanced beyond the stage of merely "Human Physiology" that it was not deemed necessary to say at all that the physiology of plants (which the old system ignored) and that of the lower animals (which, for the most part, it disregarded) are genuine branches of the now broad and comprehensive science of the dynamics of living things. So, too, with experimental psychology. The time has gone by when physiologists need to explain that they welcome this as a vigorous and promising branch of physiology.

It appears, however, that with histology, pathology and experimental hygiene and therapeutics, the case is somewhat different; and the whole section relating to qualifications for membership read as follows:—

"Any person who has conducted and published an original research in Physiology or Histology (including Pathology and experimental Therapeutics and experimental research in Hygiene), or who has promoted and encouraged Physiological research, and who is a resident of North America, shall be eligible for elections as an ordinary member of the Society."

It will be observed that histologyoa subject almost purely morphological, is included (d oubtless frm its fundamental usefulness to the physiologist), while nothing is said of embryology, which, though largely physiological, has passed almost wholly into the hands of morphologists. The name "American," moreover, seems here better justified by the geographical limit adopted than is usual in the case of such organizations.

The Place of Bacteriology in Modern Science.—The preceding paragraphs may serve to show to which hemisphere of the great biological globe this new science belongs. For if bacteriology has a place anywhere, it is surely in experimental pathology and experimental hygiene.

Botanically speaking, bacteria are of no unusual interest on the morphological side. They are too small and too undifferentiated to yield great morphological harvests, at least with our present means of study. But from the physiological side they are just now without a parallel among living things, both in interest and in importance. The deeds which they do, the marvellous effects which they produce, are out of all proportion to their apparent anatomy. Some of the steps in the progress of this new physiological science will be hereafter noted in this department, and workers are cordially invited to send to its editor brief notes, or items of interesting news in bacteriology.

ARCHÆOLOGY AND ANTHROPOLOGY.[1]

At the late meeting of the Society of Anthropology, Washington, D. C., interesting papers were read,—one by Mr. H. M. Reynolds on the subject of Algonquin metal-smiths. The writer treated with care the important question whether the Indians were acquainted with the art of smelting copper. He argued that the working of the copper-mines of Lake Superior was not of such high antiquity as has been supposed, and may have been continued until comparatively modern Indian times. The other paper was by Mr. Jeremiah Curtin, on Moqui myths.

[1] This department is edited by Thomas Wilson, Esq., Smithsonian Institution, Washington, D. C.

Colonel F. A. Seeley, of the U. S. Patent Office of Washington, is interested in the various inventions of time-keeping, and has read a paper before the Anthropological Society in Washington on time-keeping in Greece and Rome. He is pursuing the subject, and invites correspondence and assistance. He proposes to trace the existence and development of the notion of time-keeping among savage and barbarous races; also the history of time-keeping from its dawn down to the middle ages.

SPURIOUS INDIAN ARROWHEADS.—An enterprising individual in the vicinity of Orwigsburg, Pa., has recently put on the market well-made arrowheads of curious design, against which it may be well to warn collectors. These relics, instead of being made directly from flakes, are genuine arrowheads *rechipped*, thus increasing the depth of the notches, sometimes the base of the shaft, and usually allowing so much of the lateral edges of the anterior portion of the arrowhead as to make it resemble at the point a small lozenge or diamond attached to the original base by a stem. One specimen which had been broken across was retouched, so as to permit the original base to remain, but presented two points, the intervening material having been removed. Another specimen was curved or lance-shaped, a fractured surface upon one edge having been rechipped. The new surfaces may be distinguished in most instances from the original; but, after having subjected the new relics to some process of polishing, they have been buried or otherwise coated with earth, so as to produce, as far as surface is concerned, every appearance of genuine Indian workmanship.

The object of the modern manufacture appears to be to furnish curious and unique forms, which are more saleable and command a higher price than the ordinary forms, the latter being common and of no great value.—*W. J. H. in the "American Anthropologist" for April.*

The National Geographic Society has been organized under excellent auspices. The Hon. Gardner C. Hubbard is President, and the membership amounts to two hundred.

Its fourth meeting, held 30th ult., was a symposium of geographers. Each scientist was allowed ten minutes in favor of his specialty, as a contribution to the formation of a complete atlas of physical geography. General Greely spoke for the climatic representation; Commander Bartlett, for the sea and its shore; Professor Ward, for Paleo-Botany; Dr. Merriam, the distribution of bird-life. Mr. Henshaw's subject was of greater interest to anthropology. He showed the distribution of Indian languages in North America at the dawn of its history. He presented a map made at the Bureau of Ethnology, the result of eleven years of labor of himself and Major Powell. This map covers the entire area of North

America, showing each Indian language belonging thereto, with all their sub-divisions, separations, and migrations—so far as possible to be discovered at this earliest epoch. This work is as interesting as it is important, and its authors are to be congratulated upon their success. It is to be hoped that Major Powell will have the map published for immediate distribution without awaiting the long tedium of the Public Printer, whose office is now being investigated by a committee of Congress.

The appointment of Mr. Justice Lamar to a seat upon the bench of the Supreme Court of the United States marks an era in the history of our country. Every one recognizes this as true politically; but I speak of it anthropologically. Mr. Justice Lamar is said to be what is called in French "*visuaire*"—that is, mental impressions are received upon his brain with greater facility through the eye than through the ear. One who receives these impressions best through the ear is called an "*auditaire.*" The "visuaire" understands the thought best by *seeing* the printed page, while the "auditaire" receives his best impression by hearing. In the Supreme Court the arguments of counsel are, of course, oral; and how Mr. Justice Lamar, with this peculiarity of mental organization, will adapt himself to his new position remains to be seen.

These differences in human mental organization are well known to anthropologists. As some men can understand better when they see, and others when they hear, so some can think better when they speak than when they write; while others are the contrary. Governor Corwin of Ohio, was a notable illustration. Whether in the Senate, in the House of Representatives, at the bar, or on the stump, as an orator he was equalled by few and excelled by none. He thought well and clearly when on his feet. Amid all his wit and humor he was a most consummate logician, and could carry on the thread of an abstruse argument and support it by most cogent reasoning. But as Governor or cabinet officer, his state papers were not above the ordinary. Taking a pen in his hand, his thoughts seemed to scatter, and his writing was commonplace. Addressing the multitude, his thoughts seemed to crystallize into most beautiful forms, and he spake as one inspired. The causes of these differences have never been discovered. They are suggested as a theme for the student—biologist or anthropologist—as instructive as they are interesting.

"L'Homme Avant L'Histoire."—This is a new book on the subject of prehistoric man, written by M. Ch. Debierre, published in Paris. The author is a professor in the faculty of medicine at Lyons, France. M. Cartailhac, while giving it credit for much that is useful and interesting, criticises somewhat severely the mass of errors which he finds therein. Thus, page 141: "There are

stations where the debris of human work united the two ages (palæolithic and neolithic), and testify the passage from one to the other." M. Cartailhac says the author cites the cavern of Duruthy, but "that there is a superposition and not a juxtaposition between the two ages, and there is nothing to show the passage from one to the other. The sepulchral caves of Lozère are absolutely neolithic, and those of the Marne the same."

The author says "that at the end of the palæolithic age new races came from the east, invading the palæolithic people, and bringing with them a neolithic civilization." M. Cartailhac says "there is nothing to prove this."

Of the neolithic age the author says, "The reindeer was disappearing from the country (southern France)." He should have said, "had already disappeared."

Again, "some of the *dolmens* of France are known under the name of *menhirs*." He should have said, "some of the megaliths," etc.

"The men of the neolithic age immolated without doubt human victims to their gods," etc. M. Cartailhac asks "How do we know this?"

Again, "the similitude of the dolmens of India and Europe, like those of Europe *and America*," etc. M. Cartailhac says the last word should be Africa, for we do not know of true dolmens in America.

And, "it is nearly certain that the construction of dolmens was perpetuated in England and in France until near the eighth century of our era." M. Cartailhac says "this is a complete error."

L'Homme (Man).—M. Gabriel de Mortillet, of Paris, is an active and versatile professor of the science of prehistoric anthropology. He was first a civil engineer, then geologist, assistant director of the Musèe St. Germain, mayor of that city, and now a deputy of France; but all the time ardently devoted to prehistoric anthropology, and the author of many valuable works. He devised the classification of Prehistoric man's occupation of France into epochs, giving to them a defined nomenclature which has been recognized by the country at large. He has been for many years the lecturer on this science before the School of Anthropology in Paris. He was the founder of the journal *Materiaux pour L'Histoire Primitive et Naturelle De L'Homme*, now conducted by Cartailhac and Chantre. In 1883 he established the journal *L'Homme*, which he has carried on with credit to himself and profit to his readers. He announces, with the close of the last year, the cessation of its publication. His assistants and coadjutors rank amongst the highest in their special sciences in France. They are as follows:—

Embryology and Biology, Mathias Duval; Physiology psychologic, Thulié; Comparative Anatomy, Georges Hervé; Archæology

prehistoric, Philippe Salmon; Ethnography and Craniology, Manouvrier; Sociology, Letourneau; Linguistic, Abel Hovelacque; Folk-lore, Paul Sébillot; Mythology, Girard de Rialle; Geography medical, Bordier; Demography, Mondière; Philosophy, André Lefèvre.

The cause of cessation of the journal is not from failure of any kind, but from greater devotion to science. These gentlemen, individually and collectively, are the founders and organizers of the *Bibliothique des Sciences Contemporaines*, of the *Dictionaire des Sciences Anthropologiques*, and of the *Bibliothique Anthropologique*, and they have decided to suspend the journal that they may devote their entire time to the two libraries and the dictionary.

The Prehistoric Anthropologists of the United States send their wishes of fraternal good fellowship.

The enquiry started by the Smithsonian Institution in regard to the existence and geographic distribution of the so-called "rude and unfinished implements of the palæolithic type," is one of high importance in the study of American Prehistoric Anthropology. Responses have been received from thirty States and Territories, the implements already noted amount to between six and seven thousand, and their distribution extends nearly all over the United States. Several hundred implements have been sent to the Institution, some of which do not belong to any palæolithic age, but many of them do. None seem to have been found in the mounds.

The implements themselves are of no merchantable value. The Institution desires them principally for verification, to see that they are really palæolithic implements, and not the leaf-shaped spear and arrow heads so common; also to know their geographic distribution. It wishes to know, approximately, how many have been found within a given district or State, if there has been anything peculiar in their finding, position or locality, especially with reference to river gravel drift.

The present examination is tentative and does not attempt to deal with the antiquity of this palæolithic age, but only to discover if there was such an age in America, and, if so, whether it had any extended existence. The attention of the average relic collector has never been called to this sort of specimen, and they have not usually been gathered. It will be something gained for science, to know how these implements are distributed over the United States, and especially their relationship to the glacial moraines.

MICROSCOPY.[1]

A NEW METHOD FOR THE MICROSCOPICAL STUDY OF THE BLOOD.[2]—The methods hitherto employed in preparing the blood for microscopical examination have aimed either at the production of *fresh* or of *dry* preparations. Preparations of the first class are not permanent, and those of the second class never exhibit the morphological elements intact. Dr. Biondi has worked out a method which combines the advantages, and is free from the defects, of previous methods. The problem was to find the means of perfect *fixation*, *preservation*, *imbedding*, and *mounting*—in other words, a method by which the blood could be treated as a solid tissue. The method is equally useful in the study of other organic fluids, and has been successfully employed in tracing the changes that take place in the maturation of the spermatozoa. It may doubtless be used to advantage in the study of Infusoria, as suggested by Biondi.

The point of chief interest in Biondi's method is the use of *agar* as an imbedding material. Agar is a vegetable gelatine, obtained from *Gracilaria lichenoides* and *Gigartina speciosa*, and has already been successfully employed for some time by Koch in bacteriological investigations. Among the different sorts of agar, the columnar form (Säulen-Agar) is considered the best. A perfectly transparent solution is required, in the preparation of which great care must be taken. This may be accomplished in the following manner: Place two parts of agar in 100 parts of distilled water, leaving it to soften for twenty-four hours at the ordinary room temperature; then heat to boiling on the sand-bath until the agar is all dissolved. The evaporation of the water may be checked by closing the flask with a cork provided with a long glass tube. Add carbonate of sodium to the point of weak alkaline reaction, and boil for an hour in a steam-apparatus. Pour the solution into long, slender test-tubes, and leave from twelve to twenty-four hours at a temperature of 50° to 60°C. The solution separates into two layers, the upper of which is quite clear, and this layer alone can be used for imbedding purposes. But clarification must be carried still farther before it is fit for use. The clear portion of the solution is next to be heated to about 40°, white of egg added, the mixture shaken up several times in the course of ten minutes, boiled for an hour in the steam-apparatus, and then

[1] Edited by C. O. Whitman, Director of the Lake Laboratory, Milwaukee, Wis.

[2] D. Biondi. Neue Methode der mikroskopischen Untersuchung des Blutes. Arch. f. mik. Anat., xxxi., 1, p. 103, Dec., 1887.

filtered. The reaction should then be tested, and, if necessary, carbonate of sodium added until the solution is neutralized. Exact neutralization is necessary, in view of the staining fluid to be employed.

It is important that the mass should be kept sterile up to the moment of using, as otherwise a large number of micro-organisms may develop in it, and render it worthless for the finer uses. It is advisable, therefore, to keep the mass in test-tubes, limiting the quantity placed in each to the probable requirements of a single imbedding operation. For a single preparation of the blood five ccm. of the mass is sufficient. The test-tubes should be cleansed with hydrochloric acid and then washed with distilled water. After receiving the agar solution, the tubes are closed with cotton, and then sterilized in the steam-apparatus for half an hour daily on three successive days.

As the preparation of the agar mass is somewhat complicated, much time and trouble may be saved by turning this work over to some apothecary. König of Berlin (Dorotheenstrasse, 29) furnishes the mass prepared as above described.

The best medium of fixation for the elements of blood is a 2 per cent. solution of osmic acid. If a drop of blood from the frog be examined in this medium under the microscope, it will be seen that both the red and the white corpuscles are perfectly preserved in form and structure. The red corpuscles become a little paler than in the living condition, and are slightly browned. The corpuscles of mammalian blood are isolated and seen to greater advantage than in any other medium of fixation. As it is important that the acid should be perfectly clear and free from all impurities, it is well to filter before using.

Method of Procedure.—1. By the aid of a clean pipette, take a little blood from the heart of a frog, and allow two drops to fall into 5 ccm. of osmic acid (2 per cent.). Shake a little—the sooner the better—in order to separate the elements and scatter them through the whole body of the acid. After standing awhile, the blood corpuscles will be found at the bottom of the tube, the deeper layer being formed mainly of red corpuscles, which sink first by virtue of their greater specific gravity. Exposure, one to twenty-four hours.

2. The process of fixation completed, 4 to 5 drops of the mixture of blood and osmic acid are allowed to fall from a pipette into the melted agar, which is kept fluid at a temperature of 35° to 37°C. By rotating the test-tube, the blood corpuscles are distributed through the agar, and then the whole is poured into a paper box, as in the ordinary paraffine method of imbedding. Within a few minutes the mass stiffens, and may be removed from the box to 85 per cent. alcohol for hardening. In three to six

days the mass is hard enough for sectioning, and may be inclosed in elder pith and cut with the microtome.

If finer sections are required than can be obtained in this way, the agar block may be imbedded in paraffine in the following manner: The block is to be transferred from the 85 per cent. alcohol to bergamot oil (twenty-four hours), then direct to soft paraffine kept at a temperature of 45°C. After one to two hours, the imbedding process may be completed in the usual way. As the agar is saturated with paraffine, very fine sections may be obtained; and these may be freed from paraffine with the usual solvents, and then stained.

3. Sections thus prepared may be safely treated with nearly all staining media. Methyl green, methyl blue, fuchsin, safranin, etc., give the most reliable results. The agar itself is stained only by the most intense anilin dyes (*e.g.*, gentian violet), but in such cases it loses its color quickly in alcohol or in any other decoloring fluid.

4. Sections may be clarified, preparatory to mounting, in balsam or damar, in clove oil, origanum oil, bergamot oil, creosote, etc. Xylol alone should not be used, as it causes the sections to curl.

Boveri's Method of Preparing the Eggs of Ascaris megalocephala.[1]—1. The egg-sacks are plunged for a few seconds into boiling absolute alcohol which contains 1 per cent. glacial acetic acid.[2] The eggs are thus killed instantly, and at the same time the egg-membrane is rendered penetrable to the reagents. The alcohol is allowed to cool gradually, and after a few hours the eggs are transferred to pure alcohol, colored, and examined in glycerine or clove oil. This method shows the achromatic spindles and the chromatic equatorial plates, but not a trace of protoplasmic asters.

2. The following mixture was used cold, with excellent results. A saturated solution of picric acid is diluted with twice its volume of water, and then 1 per cent. glacial acetic acid is added.

The egg-sacks are left at least twenty-four hours in this mixture, then washed in 70 per cent. alcohol, stained in Grenacher's alco-

[1] *Theodor Boveri.* Zellen-Studien. Jenaisch. Zeitschr., xxi., 3 and 4, p. 432, 1887.

[2] Van Gehuchten calls attention to the fact that acid alcohol was used by Prof. Carnoy long before Zacharias published his method. Carnoy employed the following mixtures:

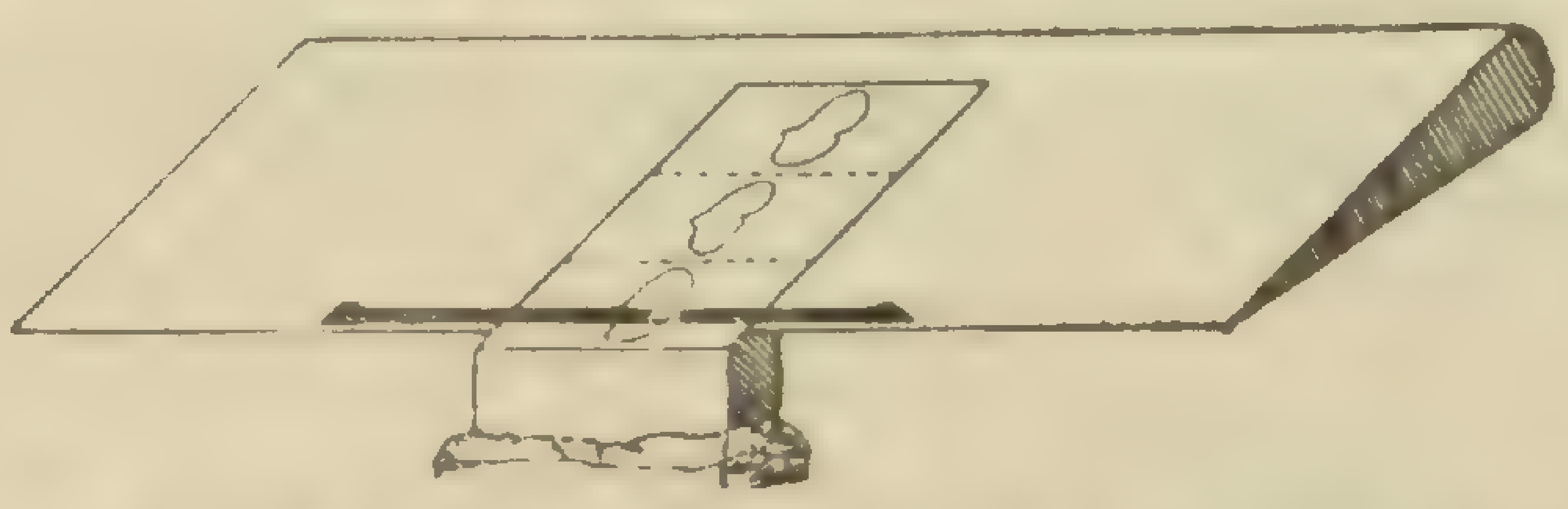
absolute alochol	6 vol.
acetic acid	1 vol.
chloroform	3 vol.

Chloroform renders the action of the reagent more rapid. *Vide*, La Cellule, t. III., f. 1, p. 6 and f. 2, p. 276.

holic borax-carmine (twenty-four hours), transferred to 70 per cent. alcohol plus 1 per cent. hydrochloric acid (twenty-four hours), and finally placed in pure alcohol.

For examination, glycerine is preferred to clove oil. If the egg-sacks are removed from alcohol to a mixture of glycerine (1 part) and absolute alcohol (3 parts), and then allowed to stand until the alcohol has evaporated, the eggs do not shrink. It will be found, however, that the eggs are not all equally well preserved with the cold mixture, owing probably to individual differences in the constitution of the membranes, some being more, others less, permeable to the fixing reagent.

AN INEXPENSIVE SECTION-SMOOTHER.—The cut shows a device for preventing the curling of paraffine sections, which is extremely



simple and easily made. After cutting off the head and point of an ordinary brass pin, fix it parallel to the edge of the knife by pressing its ends into two small pellets of beeswax. The proper elevation is easily determined by testing on the waste paraffine before the object is reached. The pin can only be used with the transverse knife. With the knife set obliquely, a piece of drawn wire will serve the same purpose.—*H. C. Bumpus.*

TABLETS FOR ANATOMICAL PREPARATIONS.—The following information respecting the materials used for mounting tablets in the Museum of Comparative Zoology has been furnished by Professor E. L. Mark:—

For dry objects, various materials have been used at different times: (1) Glass painted on one side; (2) plaster of Paris slabs, white or colored; (3) pasteboard; (4) wood, thin layers glued, with grain running at right angles; (5) slate; (6) cement. The last is worthless. Slate is now preferred.

Samuel Garman was the first to use the plaster tablets for alcoholic preparations. In the Annual Report of the Curator for 1877–8, p. 25, Mr. Garman says: "It is found that by mounting the majority of the Sauria and Batrachia on plaster tablets in jars of alcohol their value for purposes of exhibition is greatly enhanced. This takes considerable labor; but once mounted, they will need no further attention for a long period."

Garman used these tablets in his own room as early as 1875, but they were not introduced into the exhibition rooms until 1877.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

United States National Academy of Sciences. —The Academy met in Washington, commencing April 17th, 1888, and remained in session until April 20th, inclusive. The following papers were read:—"The Rotation of the Sun,"[1] J. E. Oliver; "The Foundations of Chemistry,"[1] T. Sterry Hunt; "On an Improved Form of Quadrant Electrometer, with Remarks upon its use,"[1] T. C. Mendenhall; "On the Vertebrate Fauna of the Puerco Series,"[1] E. D. Cope; "Reinforcement and Inhibition,"[1] H. P. Bowditch; "On Apparent Elasticity Produced in an Apparatus by the Pressure of the Atmosphere, and the Bearing of the Phenomenon Upon the Hypothesis of Potential Energy,"[3] A. Graham Bell; "The Orbits of Aerolites,"[3] H. A. Newton; "A Large Photographic Telescope,"[2] E. C. Pickering; "A New Method for the Biological Examination of Air, with a Description of an Aerobioscope,"[2] W. T. Sedgwick and G. R. Tucker (presented by J. S. Billings); "Preliminary Notice of the Object, Methods and Results of a Systematic Study of the Action of Definitely Related Chemical Compounds upon Animals,"[3] Wolcott Gibbs and Hobart Amory Hare; "On the Auditory Bones of the Batrachia,"[2] E. D. Cope; "The Orbit of Hyperion,"[2] Ormond Stone (presented by S. Newcomb); "Map of Connecticut River-Region in Massachusetts,"[4] B. K. Emerson (presented by J. W. Powell); "Parallel Series in the Evolution of Cephalopoda,"[2] A. Hyatt; "Evolution of Cephalopoda in the Fauna of the Lias,"[2] A. Hyatt; "The Evidence of the Fossil Plants as to the Age of the Potomac Formation,"[4] L. F. Ward (presented by J. W. Powell); "Vision and Energy,"[4] S. P. Langley; "Report of Progress in Spectrum Photography,"[3] H. A. Rowland; "Note on the Spectrum of Carbon and its Existence in the Sun,"[3] H. A. Rowland; "The Characteristics of the Orders and Sub-Orders of Fishes,"[4] Theo. Gill; "The Serpent-Mound and its Surroundings,"[4] F. W. Putnam; "The Systematic Relations of Platypsyllus as Determined by the Larva,"[4] C. V. Riley (presented by Theo. Gill); "On the Position of the Nova of 1572, as Determined by Tycho Brahe,"[4] C. H. F. Peters; "Some Notes on the Laramie Groups,"[4] J. S. Newberry; "On the Structure and Relations of Placoderm Fishes,"[4] J. S. Newberry.

Six new members of the Council were elected, as follows:—Professors Brush, Langley, Pickering, Remsen, Gould, and Gen. Meigs. Four new members of the Academy were elected—Profes-

[1] Read April 17. [2] Read April 18. [3] Read April 19. [4] Read April 20.

sors Michael and Michelson and Messrs. Chandler and G. B Goode. A rule was adopted which provides that the lists of papers of candidates for election to membership should be printed and circulated among the members, at least sixty days before the meeting of the Academy.

The Academy adjourned, to meet in New Haven in November next.

Biological Society of Washington, March 24th, 1888.—The following communications were read:—Dr. Cooper Curtice, "*Tænia fimbriata*, a New Parasite of Sheep;" Mr. Charles Hallock, "Reversion of Domesticated Animals to a Wild State."

April 7th, 1888.—The following communications were read:—Captain J. W. Collins, "The Work of the Schooner Grampus in Fish Culture;" Mr. Chas. D. Walcott, "Cambrian Fossils from Mount Stephens, Northwest Territory of Canada;" Professor C. V. Riley, "Some Notes from Emin Pasha's Travels in Central Africa;" Dr. Theobald Smith, "The Destruction of Pathogenetic Bacteria in the Animal Organism."

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GUATEMALA FORESTS.

BY MILES ROCK.

IN a general view over the surface of Guatemala we observe a great difference in the character of the vegetable covering. Little of this difference can be due to change in latitude, as the whole Republic lies within the parallels of 13° 44′ and 17° 49′, or extends only about 4 degreees north and south. In longitude, it lies between 78° 8′ and 92° 10′ west of Greenwich, or extends also 4° east and west. Roughly it is in the form of a square, of which these dimensions of 4° are the diagonals. This country is the northwestern one of the five Central American republics, and covers about one-fourth of their entire area, and is about as large as the State of Pennsylvania, 43,000 square miles, but has hardly one-third the number of inhabitants—say one and one-third millions.

What, then, are the causes of the plant diversity? They are, undoubtedly, 1st, elevation above sea level; 2d, meteorological influence of topographical features on climate; and 3d, influence of the ancient inhabitants. The first I take to be the most important cause. We have first the hot climate of the coasts, extending from sea-level to altitudes of 3000 feet, and including

(*a*) The Pacific Coast plain, some 40 miles wide and 135 long, covering 4500 square miles.

(*b*) The Caribbean Sea Coast plain, some 60 by 20 miles, including the valleys of the rivers Sarstun, Dulce, Polichie, Matagua and Zacapa, and Lake Yzabal, or Golfo Dulce, covering 3200 square miles.

(*c*) The Gulf region, or part of the great plain entering northward from the Sierra Madre, or Cuchumatanes Mountains to the Gulf of Mexico, about 150 miles square, including (1) the basin of the river Neumacinta and its four great affluents, the rivers San Pedro, Lacantun, Chixoy and Pasion, and the narrow valleys of their upper branches, covering some 16,000 square miles; (2) the valleys of the Lagartero and Salegná rivers, 250 square miles; and (3) the valley of the Cuilco River, 50 square miles, the last three rivers being the upper affluents of the Chiapas River, all these regions together making 24,000 square miles of *tierra caliente*, or more than one-half the entire country.

Secondly: A great mountain system running nearly east and west from the Isthmus of Tehuantepec to the Gulf of Honduras occupies the middle of Guatemala between the Pacific and the Gulf plains, in a succession of axes of elevation, vaults and escarpments, overlapping or arranged *en echelon*. In some ten places these mountains attain elevations of 10,000 to 12,000 feet, and elevations 8000 to 9000 feet are numerous. Between these are the many deep erosion valleys, pre-tertiary, which, in the eastern and northern parts of the country, are in the low, hot lands, but in the western and southern parts are filled in with volcanic debris, some trachyte, but mostly ashes, forming extensive and curiously level plains, surrounded by high mountains. These ash plains are from 5000 to 7000 feet above the sea, and form the larger part of the temperate region, or *tierra templada*, and are the sites of most of the cities and large towns, the seat of most of the population, and mostly cleared and cultivated, now and since remote times, as shown by ancient remains. These plains are often traversed by impassable barrancos, or ravines with vertical sides eroded through the ash beds since Pliocene times, by small swift rivers, often to depths of 300 or 400 feet.

The temperate regions, from 3000 to 9000 feet above the sea, cover about 15,000 square miles, or one-third of the whole surface of the Republic.

Thirdly: We have the remaining one-tenth of the country, or 4000 square miles, rising above 9000 feet, and in at least two table lands, those of Ixchignan and Chémal, extensive table lands at 11,000 and 11,500 feet, and which are traversed by ridges 1000 feet higher, and finally, there are six volcanic cones attaining from 13,000 to 14,000 feet elevation.

I have one comment more to make on the face of the country to complete the view, as the matter is usually misunderstood. The twelve or more volcanoes of Guatemala, of which only two show a slight activity, do not form the culminating points of its mountain masses, but are seated on the southern slopes, facing the Pacific, shooting up in beautiful symmetrical cones, with straight slopes almost from the sea-level to the point, looming up, viewed from the Pacific, in solitary grandeur, 3000 feet above the lofty sierras behind them. It is one of the great and inspiring sights of the world to thus see close together the three cones of Agua, Fuego and Acatenango, and the Spaniards could not help but place them on the escutcheon of Guatemala as the symbol of this beautiful land.

Let us begin at the top of one of these towering, awe-inspiring volcanoes, 14,000 feet above the sea, as Agua, or Tajumulco or Tacaná, and take a general view of the vegetation on our way down to the sea-level. On Tajumulco I spent two days and on Tacaná eight, to make observations. It was bitterly cold, day and night, reaching 8° F. above zero. The piercing winds blew at times so one could hardly stand up. Large lava stones were piled against the tripod to keep the theodolite from falling over. Hail storms, with terrific lightning and crashing thunder enveloped us. Owing to rarity of air some of the people became sick and had to be sent down. The volcano was extinct (Tajumulco), but several acres of calcined and crumbling rock, and fissures and holes lined with sulphur crystals and incrustations show that not many years ago it burned. On a part of the crater rim were stuck many crosses and notched sticks where the Indians come to perform their ancient religious rites. On Tacaná two *Chinams* (priests) came up and performed a sacrificial rite with a turkey in my presence after I convinced them that I was from another country and would not betray them, for such rites are forbidden. The view extended over the coast plain and many miles over the Pacific to an indistinguishable horizon, where sea and sky blended; but at sunset one could see where it came, apparently up in the sky.

Round about the crater was only sterile desolation, but on descending one soon sees dry grasses, low weedy herbs and stunted pines and cedars. From 500 to 1000 feet below begin pine forests that extend down to 9000 feet above sea-level. There are

also other trees and shrubs and flowers, the last mostly at the top of precipices, the sides of waterfalls, or wherever the sun can get to the ground.

In tropical woods there is not such a profusion of beautiful flowers as in the colder climates; they are too meek and lowly, can get no sun, and are choked out. I have noticed that where trees can get no hold, as on precipices, the rocky banks of rivers, or on narrow promontories jutting into lakes, a great variety of flowers occur; also in abandoned mountain meadows, where the ancient people cleared the forests away, I have noticed ranunculi, violets, geraniums, fuchsias, begonias, compositæ, lilies, whortleberry, abutilon malvas, the wild dahlia, and a host of others.[1] This general shutting out of the sun from the ground accounts not only for the lack of wild flowers, but also for the striking abundance of twining and climbing plants. On the higher volcanic slopes are many vines, and among others a blackberry and a tomato that go straight up to the tops of the highest trees before they branch out and spread their leaves to the sun. The way to gather berries of both is to cut down the trees, and when a tree falls the Indians run to where the tree-tops land, to get the berries.

At places where large wet surfaces of lava have no covering of soil, they are carpeted over with thick beds of mosses and ferns. In descending the volcano Tacaná, when I first came to such an open place without knowing its character, I began to slide with the green carpet, and, there being no bushes to take hold of, kept on at a dangerous pace until a fallen trunk stopped the avalanche.

The trade winds from the Caribbean Sea bring such abundance of moisture that all summits and slopes exposed to them are incessantly enveloped in mists, and the woods are dripping as with rain. These are also the regions of heaviest rainfall during the rainy season. Owing to this excessive moisture one finds the great tree-fern growing at exceptional altitudes, at 9000 feet and over, above the sea. They attain a height of twenty to thirty feet, and a diameter of trunk of even one foot, and occur in greatest abundance on the north slopes of the volcano Tacaná.

From 11,000 to 8000 feet is truly the forest region, characterized by great variety and heavy growth. There are many hard woods, of

[1] But orchids, epiphytes and other flowers, as well as ferns, mosses and lichens whose habitat is on trees, abound universally throughout the forests and at all elevations, but varying in species.

beautiful colors, as bright yellow and rosy red, that would be most valuable for cabinet-making were they accessible, but to bring them out would be too costly.

I have mentioned the pine already. There are at least three species. One is the *Ocóte*, which is very rich in resin, and is used all over the country for light. In every hut three stakes, or a three-forked stake, is driven into the earth floor; a flat stone, or water-jar, is placed on top about three feet from the ground, and on this a few finely-split sticks of *Ocóte* are kept burning, and a child has the duty of replenishing it from time to time with fresh sticks.

I have seen mule-loads of these split sticks on the way to city markets, and in Guatemala city the *Ocóte* sticks hold their own against the electric light. In the low country, in districts where no *Ocóte* grows, some trunk discovered on a river bank, borne down from the mountains by freshets, is a treasure, and supplies the inhabitants with light until it disappears piecemeal. This pine grows at all elevations in the temperate and cold climates, and is the characteristic tree on the volcanoes, on the ash beds, but here mostly cleared away except in barrancos, and in sandstone soil. There are also some remarkable pine forests near the sea-level. We thus see the pine growing from sea-level to the highest summits, and on the volcanoes to over 13,000 feet high, either in exclusive forests or mixed with other trees. There is a species of pine that is of rare occurrence in the temperate belt. It is called the "holy pine," but I have not learned the reason. Perhaps because crosses can be easily cut from the limbs, from its regular opposite branching. Its needles are very long, and bark smooth.

There is a curious tree belonging to the order of the Compositæ that is confined to a particular elevation in a marked way. It is rather gnarled and crooked in shape, but with trunks over a foot in diameter, and reaching a height of thirty feet. Its leaves are willow-shaped, nearly a foot long, glossy green above and white tomentose beneath, and clustered at the end of the branches. The flowers are yellow, sunflower-like, an inch or more across, and arranged in large racemes. This tree is so entirely wanting at lower levels, and so regularly makes its appearance at 10,000 feet above the sea, that we call it "our 10,000-footer." It hardly extends 1000 feet in vertical range. At these elevations occurs another

curious tree looking like a gigantic laurel bush, much twisted, gnarled and recumbent, with a smooth red bark, peeling off like the buttonwood.

Another tree of limited range is the *Pinabete*, a spruce. I have noticed it on the Pacific side, at elevations of 9000 feet. It has given its name, *Pinabete*, to a range of mountains on which it is common.

At the upper limit of the temperate belt begins the occurrence of the cedar, or cypress, a lofty tree of large diameter, forming an extensive forest on the table land of Serchil, east of the volcano Zajumulco. In single trees and groups it occurs on many mountains, and especially in the great steep mountain ravines. This tree is much used by the natives in their constructions, being so easily worked. It is especially used for making planks. These are made by edging a section of a trunk of proper length on opposite sides until the finished plank remains. The trees are of such diameter that a single width serves for benches, tables and doors.

A cedar, perhaps a different species, grows in the hot country, and is used to make *cayukas*, or dug-out canoes, and oars. They are light and durable, and large trunks make canoes that carry many people or heavy loads of corn or salt, perhaps four or five tons. They are very sea-worthy, I have safely crossed a lake in one in a storm when the waves ran three to four feet high.

The most characteristic tree of Guatemala is one whose name or botanical relations I have not learned. It is the tree that densely covers all the higher summits. In the case of pines, cedars and oaks, it is a question whether the forest is primeval, or has grown upon ground once cleared and cultivated, but these summit forests have clearly never been touched by man, and in the deep recesses of these woods among mossy rocks, in dripping mists and shut in from the sun one can feel that he is where no human being has ever been before. These trees have large and lofty bare trunks, in appearance like our white oak, but the tops, from the small, glossy green leaves and the dense spray look like the box, and we call it the "box-tree." Where these forests occur I have never found any ruins, and I am sure man has never occupied that ground. On those table lands and slopes where the forests of this tree have been cut off, they do not appear to grow again, but are replaced by pine, or remain clear and afford pasture for flocks of sheep, from which the Indians derive the wool for their clothing and blankets.

These extensive pastures are close-cropped, and poor because of two creeping herbs that carpet the ground, flat and close-pressed to the surface. One of these is a geranium. These pastures have existed probably for centuries, and are mostly above 9000 feet. Below this altitude, next below these pastures, considerable wheat is grown; also some corn, but this does not thrive well above 8000 feet, but below that elevation it is the principal crop to the sea-level, and is the universal and chief food of all the people.

At 8000 to 9000 feet we are also in the region of the potato. These are small, but have such a nutty and delicious flavor that, cooked in their jackets one can eat them like nuts, without any accompaniment; not even salt seems necessary. They are never planted, but in the dry season a row of men and women begin at the bottom of a slope and hoe the ground down-hill-ward, picking up all the tubers that appear, and enough remain for seed for the next crop, while at the same time the ground is made mellow for their sprouting, all over the ground as if they had been sown. These potatoes are packed in nets or large leaves lined with grass, and carried on the Indian's back to the lower country and the cities for sale.

To make the story complete I must add oats to the list for this region, but they are raised only to a small extent, and not at all by Indians, and only for the horses of the hated white man.

And now we must descend lower and leave this lovely and attractive region of bright sun and balmy breezes on one day, or on one side of a mountain, and of driving mists and chilly winds on the other. The conditions of life seem near perfection, no enervating heat, no insects, no malaria, seldom frost, and no snow, hail, or other inclemency. It is a sanitarium unexcelled, and would be a perfect resort for summer or winter, and may be when the Inter-Continental Railway is built. On these charming *altos* and table-lands the native races have lived for ages, slowly gaining headway on the forests and deriving a subsistence, as do their descendants at the present day, by the cultivation of *corn* chiefly, and also *frijol*, or black beans, potatoes, a sweet pumpkin, and *chile*, or red peppers. As now, they made their picturesque clothes from the cotton of the hot lands, and the wool of the cold. But, though they lived in a Paradise, and perhaps for that fact, they do not seem to

have lived in peace. The many languages surviving to this day in mere fragments of tribes, in isolated patches, and often mixed, would seem to show that many different peoples came here and took possession of the fruit of previous occupants, and were in their turn subdued or driven away from their mountain fields. Thus the cupidity and necessity of races or classes is ever making turmoil and changing the established order. These people seem fixed to their soil, like the very trees. Sometimes a village seems all that remains of a race, surrounded by other languages, unintelligible to it. The languages, traditions, and racial characters of the various tribes of Guatemala Indians are a rich field for the study of anthropologists, and is almost unknown, save what the German, Dr. Behrendt, did in his short life, and whose manuscripts fortunately fell into the hands of our own accomplished anthropologist, Dr. Brinton, of Philadelphia, who is giving the results to the world.

As we descend below 8000 feet the oak becomes an important element in the forests. There are several species of the scrub, black and willow, or chestnut kinds, and none like our white or red oaks, as far as I have seen.

As the pine characterizes the lava, ash and sandstone soils, so the oak does the limestone and schist, as well as ash soils. The oak forests are generally more sparse than others, and seem secondary; that is, have overgrown ground cleared one time by the ancient inhabitants. On lava and ash soils, especially on rocky slopes and in barrancos, the pine and oak are often mingled. Along the ancient Indian roads are rows of oaks, with curiously gnarled and curved trunks, looking very ancient. This oak often divides near the ground into two horizontal arms, and from these several vertical trunks rise up into low trees. There are also other common trees along the ancient paths, an elderberry of tree-like size and form, and a euphorbia, low and gnarled, but with trunks several inches diameter; also cactus trees, wild cherries and box elder. At this altitude, also at 8000 feet in the upper temperate belt, occurs our own well-known sweet gum, the *Liquidambar styraciflua* L. I have met it only on the Pacific side, and on one mountain of the interior, forming green groves about springs and brooks on the mountain side, while all the other trees were brown or dull in the dry season and in the dry belt.

From 7000 to 3000 feet elevation the country is so thickly inhabited, cleared and cultivated that the forests are small and unimportant, except on the Gulf slope of the mountains, where the forests are very dense and little known. I have penetrated through them for three years, yet can hardly say I have seen them. One must hew a path through them with axe and cutlass, and can see only the numberless and thickly matted and intertwined vines, lianes and briars, ferns, bamboo-grass and knife-grass, will brush and bother unending, and the close-standing trunks of the unknown trees; but their flowers or foliage never. After three years I have not yet seen the leaves of the cedar, mahogany, silk-cotton and others whose identity I have otherwise learned.

But the reason partly is that I had duties that prevented my making a special study of such matters. I have gone up mountains where the underbrush was so densely matted that my cutter ahead would open only a tunnel next the ground high enough for us to crawl on hands and knees for distances of several hundred feet at a time. Such circumstances are not favorable for observations of Nature.

At these middle altitudes fruit trees come forward; but there are very few wild fruits—a wild plum, a wild cherry like ours, the large zapate and the manzanilla, are all that occur to me. The plum is yellow, and rather sour and astringent. The wild pigs, or peccaries, of which there are three species, are very fond of them. The monkeys, of which there are two species (the Spider and the Howling), live to a great extent on the zapate, whose tree is large and lofty. The Indians are also very fond of it, and make distant excursions into the woods to hunt for it and for wild honey. Sometimes in the depth of the woods one comes to a large zapate tree, with a rude ladder of poles fastened to the trunk extending up to the top, for gathering its fruit. Some families keep secret certain zapate and bee trees, and visit them each year. Of cultivated fruits at these altitudes there is the Agnacate (called Palta in Peru and Alligator Pear in the West Indies), the apple and the peach. There are few Indian villages and hamlets that are not rosy with peach blossoms in the season. Rose bushes, too, and geraniums in profusion are about their huts and fences. Apples are not so common, and appear to be of late introduction. Coffee comes into cultivation at 6000 feet, but thrives best at 3000 to 4000 feet.

And now comes to our notice the silk-cotton tree, or Ceibo, with its great buttressed trunk and its wide-spreading branches. This tree is very common in all the lower forests down to sea-level. The wood is light, and often used for dug-out canoes, but they last only two years without decaying. There is another tree, with a beautiful straight cylindrical trunk, whose wood is so soft and elastic that an axe almost sinks into it at one blow, and can hardly be pulled out again. There is still another peculiar tree whose wood is so hard that, in spite of efforts, I have never known one to be cut down, the cutters always giving up in despair, and when it has to be removed the Indians build a fire around it, and keep it up until the monarch falls.

Already before we pass below 3000 feet the sugar cane and cotton are planted, but coffee at 6000 and cane at 4000 are on rare occasions killed by frosts, as happened winter before last, produced by the same cold waves that carried destructive frosts to lower Florida and Cuba. Also now occur all the well-known tropical fruits, — mango, orange, lime, pineapple, plantain, custard apple and banana, and they improve downwards to sea-level.

Below 3000 feet, in the *tierra caliente*, we are in a torrid climate. Everywhere, except in the dry belt, vegetation is exuberant, overpowering. It is a hard and expensive struggle to keep ground open enough for cultivation, and neglected ground soon reverts to forest. Even in inhabited parts all the unused spots of ground are so covered that houses and fields are hidden in a general view, and it seems a marvel where all the people live who are known to inhabit the place. But the greater part of Guatemala below 3000 feet is now uninhabited, and covered with rampart forest, primitive or secondary. Two ancient cities are found in this forest, and at many other places are remains, showing that in ancient times a dense population existed where now is forest.

These forests at sea-level have been described by others in terms of admiration and rhapsody, as by Charles Kingsley, and I need not undertake it. I have travelled by canoe up and down various rivers for some 800 miles, on broad expanses with views over desolate marshes, and in profound narrow channels hemmed in by lofty precipices, and under a leafy archway, the branches of trees on the two banks meeting overhead. Sometimes two opposite fallen trees will bar the way, and an opening has to be cut. A

peculiarity is that one cannot boat along the shores, for trees overhang and shoot out at all angles over the water to reach the sun with their tops. There is a palm-tree that has the peculiarity of sending its trunk out horizontally from the bank, only a few feet from the water, for some forty feet, and then turning up vertically and spreading its crown of leaves to the sun.

There are very many species of palm. Most of them are in the hot country, and in rich, moist hollows, or on river bottoms. Many send up their leaves in graceful sweeps from a subterranean stock, others rear their crowns on lofty shafts. The cocoanut palm likes the immediate sea-shore best, the manuca, flourishes along the great rivers. There is a peculiar palm that prefers the dry belt, abounds on rocky hills, and extends up to 5000 feet above sea, or over. This is highly valued, its leaves being used for weaving hats and *petates,* the mats or palm cloth universally used for sleeping rugs and for wrapping baggage and goods for transportation by mules or on the backs of Indians. Palm-leaves are very extensively used in hut-building, especially roofing; also by travelling parties, to make temporary shelters, called *Chiampas,* to pass rainy nights in the woods. But it requires the skill of the Indians to make them waterproof. In a few minutes fifty men can erect these chiampas, and sleep dry all night in a pouring rain.[1]

The mahogany, of which there are two or more species, never forms a forest, but occurs in clumps or singly among other trees, and the same is the case with the rubber tree, of which also there are several species. These trees occur scatteringly through all the forests, aggregating a great total. During a freshet I have seen hundreds of mahogany logs dashing down the rapids of the Mumacinta River, to be caught up and loaded on ships at its mouth on the Gulf. Also many cedar logs came down from the upper affluent, the Ococingo River. The rubber trees are not cut down, but only bled at intervals, until they succumb. The white sap, or rubber milk, hardens in the air to brown-black, quivering cakes, which are carried by men, mules and canoes to the sea-coast for shipment. The rubber-hunters penetrate the woods everywhere, and endure great privations; they have no fixed abiding-place, but move from tree to tree, gathering their crop pound

[1] On swampy sea-shores and up the swampy rivers and on coral key the impenetrable mangrove holds sway.

by pound. On the contrary, the mahogany-cutters, when a place is found with enough trees for a season's cutting, build themselves a village of substantial huts and keep house, bring with them into the forest wives, children, pigs, chickens, dogs, and all their *lares* and *penates*. They may stay one year, or many. But finally, the woods being exhausted of suitable trees, they all depart, the houses decay and fall, the forest regrows and resumes its sway, and all that remains years afterwards are a few stunted banana, orange and mango trees, smothered and hidden by the lusty native forest. There is a large tree very frequent in the dry plains and low hills of the hot lands called the *ramon* tree. Its leaves are glossy green and leathery, of small size, and afford, with the twigs, a most nutritious fodder for cattle and mules. When they have it they will not touch grass. It is sweet and mucilaginous. For months my mules have depended on it. I had nothing else to give them.

Last of all we come to the logwood, which grows only along the margins of sluggish rivers, lagoons and marshes and in swamps at or near sea-level. I know of two species, brazil-wood and campeachy-wood. The latter is the most valuable, I suppose, because the color of its decoction more closely imitates the color of the red wines, in whose manufacture it is so extensively used. As our imported wines bring high prices, logwood has a corresponding value. It sells by the pound. It is a heavy wood ; a stick four feet long needs to be only a few inches in diameter to weigh 100 pounds. On account of its peculiar habitat it is hunted by canoe, and when cut has to be carried by canoe to some shipping-point. It cannot float. It sinks to the bottom like a stone. During the last 300 years thousands of tons of it have been shipped from Belize, and by accident so many logs have sunk to the bottom of the harbor and been lost, that now, when it is proposed to dredge the harbor to improve it and fill up certain shallows in the manner of the Potomac Flats, it is believed that the recovery of this logwood will go far towards paying for the work.

The second cause for the diversity of plant life I gave as the meteorological influence of topographical features on climate. As the moisture-laden trade winds from the Caribbean Sea reach the land, and they are deflected upwards more and more as they blow inland, and as the mountains rise higher and higher. This ascension

rarifies the air, cools it and reduces its capacity for holding aqueous vapor, and results in condensation and copious rainfall. It is like squeezing a saturated sponge. When the culminating summits of the Cuilco Mountains, the Sierra Madre, Sierra de Chania and Sierra de las Minas are reached, the last squeeze is given to the sponge and the winds cross over to the interior table lands, dry. This causes a dry belt along the leeside of these mountains extending from Facaná and Cuilco in the northwest by way of Huchuetenango, Chiantla, Rabinal and Salamá to Zacapa and Chiquimula in the southeast. As the air descends from summits of 12,000 to 8000 feet high to the interior plains of only 7000 to 1000 feet elevation, it expands again and takes up moisture from the soil, dessicating the climate further and making the dry belt a very marked feature of the country. One writer even calls the low hot plains of Zacapa a "desert." The pine is very common in this belt at all elevations in favorable situations, and also the oak above 3000 feet. In the driest parts and in rocky places the character of the vegetation is special and peculiar. Cacti, thorny mimosæ, and many kinds of thorny and prickly shrubs abound. As the air rises again, or the higher currents reach the summits of the mountains facing the Pacific, the sponge, replenished from evaporation over the dry belt, is squeezed again, causing mists and copious rain, and limiting the dry belt to the south and southwest.

The Pacific slope has a moist, tropical climate of its own from the influence of the ocean winds, and is independent of moisture brought from the east.

Finally, I have to mention a third great cause affecting the forests of Guatemala; the influence of the ancient people who cleared nearly or quite all the ground that is cultivated or pastured to this day, and much more besides that has become overgrown again with forests. The general proposition will hold that all the clearings of the ancient people in the dry belt, and most of them in its semi-dry borders, have remained cleared, whether cultivated and pastured or not, excepting grass, weeds and shrubbery scattered and in clumps. But to this general rule there is a remarkable exception. In favorable situations, as to moisture and depth of soil, pine forests, with some oak, cover the ancient fields and village sites. In such clean open pine forests, terrace walls, ruined structures, and whole villages are found, but all very ruined and ancient-looking.

A great pine tree may blow over and expose under its roots a stratum full of potsherds and other remains. Not far off open pine woods may border on a dense primitive forest hardly penetrable, the line between the two sharp and distinct, showing where the ancient axeman stayed his hewing. Pine forests also cover the country about the ancient city of Quirigua, on the Caribbean Coast, and I believe cover the fields of the dense population that must have supported a city so great as shown by its numerous and artistic sculptured remains. The city of Zikál is also hidden and covered up in the deep woods, with some of its walled towers yet reaching above the great forest trees, but I do not know whether these are pines. It appears then that many primitive angiospermous forests have been replaced by pine forests through the intervention of the ancients, but in the moist hot regions other angiospermous forests have followed the primitive ones destroyed by man.

In the valleys of the Salegná and Lagartero the heavy rains have denuded the ancient fields of their soil, leaving a stony desert over many square miles, and where forests can never again find a footing. And these curious stony regions now deserted and desolate are strewn everywhere with remains of former populations.

In the Petten, in the northern part of the Republic, are great areas, bare of woods, and grass-covered, called *Sabanas*. These are also ancient fields, now unused and unoccupied except at a few small villages for raising cattle. The limestone hills and ridges remain covered with the primeval forest, and at their bases and also at the borders of the inhabited regions the line of division between *Sabana* and forest is as sharp as when the ancient man made his clearings.

I recognize two causes that in their combined action have prevented the renewal of the forest. These *Sabanas* are in the middle of the lowlands between the Caribbean Coast and the mountains. As the saturated winds reach the forests on the Coast, their cooling influence causes heavy precipitation, the same as a mountain. The coast rains are well-known. But as the winds go over the interior plains without ascending, no further precipitation takes place till they reach mountains; hence the middle plain acquires the character of a partially dry belt, so that for several months in the dry season no rains occur, and the ground is parched and the vegetation partially dries up.

Now it happens that the region cleared by the ancient inhabitants has a tough clayey soil of such a nature that it bakes dry and hard in the dry season; grass and weeds dry up, and young trees that would germinate in the wet season are as regularly killed in the dry. These Sabanas show numerous ancient remains; and these and also the pine forests deserve to be thoroughly examined by archæologists. Much might be learned to shed light on the studies already made on the more modern ruined cities and sculptured temples of Central America.

MOUNTAIN-UPTHRUSTS.

BY CHARLES A. WHITE.[1]

CERTAIN of the mountain ranges of the western portion of our national domain exhibit in a clear and striking manner the evidence that they have originated in uplifted folds of the earth's crust. One of the simplest and most characteristic of these orogenic folds is the one in which the Uinta Range of mountains originated.

Other uplifts of a similar character have occurred, but which, having been of limited longitudinal as well as lateral extent, have resulted in comparatively small clusters of mountains, and not in mountain ranges proper. The Black Hills of Dakota have originated in one of these circumscribed uplifts.

In Northwestern Colorado two uplifts occur which, so far as the character of the displacement and of the formations involved are concerned, are similar to those which have just been referred to; but they have occurred within such narrow limits, respectively, that they have each resulted in only a single mountain. The limits of each of these uplifts are so sharply defined, and the amount of vertical displacement of the strata involved is so great, that I have designated them as upthrusts.

A description of these upthrusts is the special object of this article. But as they are structurally connected with the great Uinta fold and with other neighboring displacements, it will be necessary to devote a considerable part of it to their description also.

[1] Published by permission of the Director of the U. S. Geological Survey. The substance of this article will be embraced in one which is to appear in his Ninth Annual Report.

The great Uinta fold has usually been described as terminating abruptly in Northwestern Colorado. As a conspicuous fold it does so terminate there; but continuous with its axis to the eastward there is a long, gentle anticlinal, which reaches by a broad curve to the foot-hills of the Park Range—a western porton of the Rocky Mountain system. This I regard as a continuation of the Uinta fold far beyond its reputed termination, and also, in connection with other facts, as indicating structural relationship between the Uinta and Park Ranges. I therefore divide the Uinta fold into two portions—namely, the Uinta fold proper, and the inceptive portion of the same.

The Uinta fold proper is about one hundred and fifty miles in length, and from thirty to forty miles in width at the extreme limit of the upturned strata at either side. Its western end is blended with the Wasatch Range in Utah, which it meets at nearly right angles. Its eastern terminus is about thirty miles within, and east of, the western boundary of Colorado, and about the same distance from the northern boundary. Its axis, except the slight southward inclination of its eastern end, is approximately east and west, and at nearly right angles with that of the Park Range.

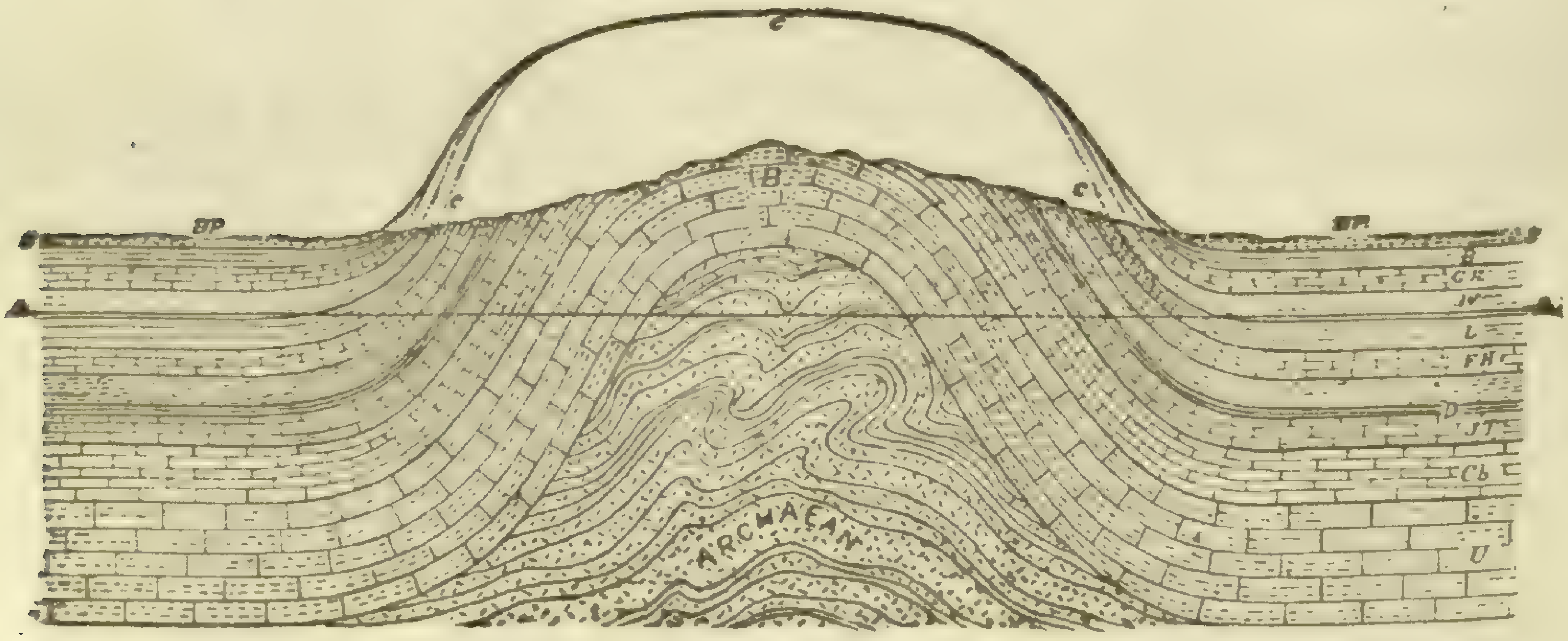


FIG. 1.—A generalized section across the Uinta Fold.

This great fold is remarkable for its simplicity, its almost entire freedom from lateral complications, and for the extent of its vertical displacement. Its type of uplift is also peculiar, the sides being abrupt and the top broadly convex. The accompanying generalized section across the fold (Fig. 1) indicates its general character, and also shows the formations which are involved in it.

The irregular line, SS, represents the land-surface, and the straight line, AA, the sea-level. The dotted line at either side of B represents the depth to which Green River has cut its cañon in traversing the Uinta Range. The dotted lines above the surface-line represent the portions of the formations which have been eroded, and the extent to which they would have been elevated in the fold if they had suffered no erosion.

The dotted line, ccc, is continuous with the top of the Laramie group. This indicates that all the formations below that line were fully involved in the fold; while the other dotted lines which lap upon either side represent the eroded portions of the four fresh-water Tertiary formations, which were successively less and less involved in the fold as the elevation progressed.

The initial U. indicates the Uinta Sandstone; Cb. indicates the Carboniferous; J. T., the Jura-Trias; D., the Dakota Group; Co., the Colorado Group; F. H., the Fox Hills Group; L., the Laramie Group; W., the Wasatch Group; G. R., the Green River Group; B., the Bridger Group, and B. P., the Brown's Park Group.

The following table gives the names and the ascertained thickness of the formations which are more or less involved in the fold, or which occur in its immediate vicinity:—

Cenozoic	Tertiary	Brown's Park Group	1200– 1800 feet.
		Bridger Group	100– 2000 "
		Green River Group	1400– 2000 "
		Wasatch Group	2000– 2500 "
Mesozoic	Cretaceous	Laramie Group[1]	2000– 3000 "
		Fox Hills Group	1800 "
		Colorado Group	2000 "
		Dakota Group	500 "
	Jura-Trias		2500– 5000 "
Palæozoic	Carboniferous		3000– 4000 "
	Uinta Sandstone		12000–14000 "
Archæan			....

The facts upon which the construction of the foregoing generalized section is based indicates that all the formations, from the Uinta Sandstone to the Laramie Group (inclusive), were fully involved in the great fold, and that the four fresh-water Tertiary formations are only partially involved in it. The latter formations were respectively deposited in large fresh-water lakes, the existence, height and limits

[1] I here provisionally place the whole of the Laramie Group with the Cretaceous formations.

of each of which were determined by the successive changes in the configuration of the land-surface, as elevation and degradation progressed.

Again, although the Archæan rocks are theoretically represented in that section, they have not been brought to view in the axis of the fold, because even the immense erosion which the uplifted strata have suffered has not been sufficient to reach them there.[1] Therefore, in estimating the amount of vertical displacement which has taken place in the Uinta fold, I have reference only to the formations from the Uinta Sandstone to the Laramie Group (inclusive).

Now, referring to the foregoing table, we find that the minimum thickness of these formations aggregates twenty-three thousand eight hundred feet. Add to this five thousand feet for the height above the level of the sea at which the lowermost strata of the Uinta Sandstone have been observed, and we have an aggregate of twenty-eight thousand eight hundred feet. The evidence seems to be conclusive that the elevation of the fold began immediately upon the close of the Laramie period; and it is confidently assumed that none of its strata were then much if any above the level of the open sea. Hence the conclusion that the full amount of vertical displacement in the Uinta fold has not been less than twenty-eight thousand eight hundred feet.

The evidence derived from a study of the great fold seems also to be conclusive that its elevation was continued between the close of the Laramie period and the close of the Tertiary; and other evidence is equally conclusive that continental elevation was continued during the same time. That is, it is assumed that the orogenic movements which have resulted in the production of the Uinta and other mountain-making folds were approximately synchronous in their origin and coeval in their duration with the epirogenic[2] movements by which the great continental area upon which those folds now rest was raised to its present elevation above the sea.[3]

[1] Archæan rocks are exposed within a limited area upon the northern side of the fold; but they were evidently a part of an uplift which was older than the fold.

[2] Etym., *Ἤπειρος*—mainland, or continent.

[3] Certain epirogenic movements must necessarily have taken place to form the barriers by which the Laramie sea was cut off from the open oceans. Local unconformity among the Laramie strata which has been observed near the top of the group in Southern Wyoming indicates that certain other premonitory movements took place before the Uinta fold was well defined.

The inceptive portion of the Uinta fold is, of itself, by no means a conspicuous geological feature—first, because a broad valley or basin, which I have called Axial Basin, is formed along the greater part of its length by the erosion of the strata which have been uplifted there; and second, because the uplift is comparatively slight. A transverse section (Fig. 2) across Axial Basin shows the character of this portion of the fold, and it also shows the formations which are involved in it.

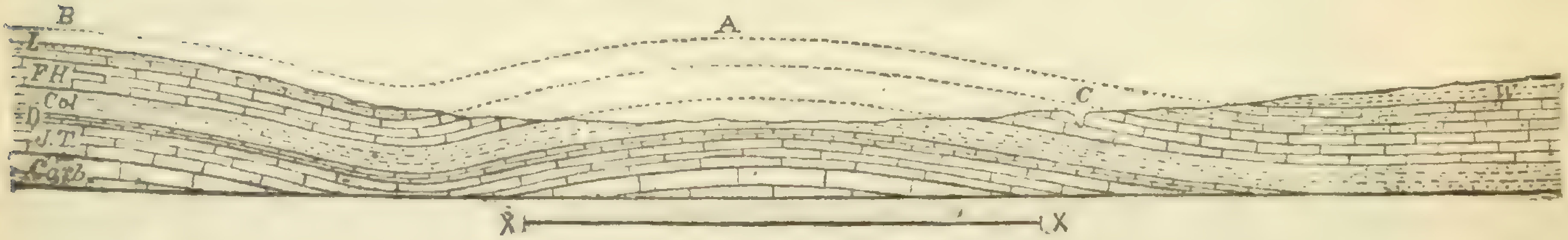


FIG. 2.—Transverse section across Axial Basin.

A. indicates the axis of the inceptive fold; B., the north base of Danforth Hills and a part of that uplift; C., Yampa River. Carb. indicates Carboniferous strata; J. T., Jura-Trias; D., Dakota Group; Col., Colorado Group; F. H., Fox Hills Group; L. Laramie Group; W., Wasatch Group. The line xx indicates proportionally the longer diameter of the Yampa Mountain upthrust, and also its position with reference to the inceptive axis.

Horizontal scale: 4 miles to the inch.

Vertical scale: 1-12 inch to 1,000 feet.

This comparatively slight fold becomes of great importance because of its evident relation to the great Uinta fold, and especially because of the presence upon its axis of the two upthrusts which have been already referred to, the presence of each of which is marked by an isolated mountain which rises abruptly out of Axial Basin. These are, Junction and Yampa Mountains, which are plainly outlying, isolated members of the Uinta Range.

The main portion of the Uinta fold terminates at its eastern end by a dip of the uplifted strata which is quite as abrupt as that at either side of it, and which carries them far beneath the surface of the adjacent lowland. Going now, only two or three miles eastward from this eastern terminus—where we have seen the later formations dip so suddenly from view—we come to the western border of Junction Mountain upthrust. Here we find the same strata to rise again, even more suddenly than they disappeared; and

we also find that the formations of Palæozoic age—which constitute the high mountain-peaks of the Uinta Range only a few miles away—are here again uplifted, not only to the surface of the low land around the mountain, but to a maximum height of nearly two thousand feet above it. The strata involved in this uplift—which, because of its sharply-defined limits and of the vertical displacement of these strata, I have called an upthrust—occupy an elongate oval area, the extreme longer diameter of which is nearly twelve miles, and the shorter about four miles. The direction of the longer diameter, being in a northwestward and southeastward direction, is obliquely transverse to the general trend of the axis of the Uinta fold. In this respect, as well as by the peculiar character of displacement of the strata involved, the isolation of this upthrust is quite complete, although it lies so near the terminus of the main portion of the Uinta fold and upon the axis of its inceptive portion.

So sharply have the strata been uplifted in this displacement that they are either faulted or are nearly or quite vertical at a portion of each side of the upthrust, and they also dip very abruptly at other portions and around its ends. The Mesozoic formations, through which the older ones were forced, lie all around the mountain, but immediately adjacent to it they are largely covered from view by the strata of the Brown's Park Group, which lie unconformably upon them. The disturbance which these Mesozoic formations have suffered in that neighborhood beyond the base of the mountain is so slight that one cannot recognize it as having been connected with the upthrust movement. That is, their position as marking the presence of the inceptive portion of the Uinta fold and of certain subordinate uplifts does not seem to have been changed by the localized upthrust movement.

The Mesozoic formations,—which must have necessarily risen on the top of the older ones within the upthrust area,—have been removed by erosion, as has also a large part of the full thickness of the Carboniferous strata which came up beneath them. Therefore, only strata of Palæozoic age now enter into the structure of the mountain proper; while the upturned edges of the later ones, where they have not been sharply severed by faulting, lie around its base.

Going from Junction Mountain about sixteen miles along the axis of the inceptive fold, we pass all the way over the low lands of Axial Basin, the surface of which is there mostly occupied by the

FIG. 3.—Section showing the eastern end of the Uinta fold, and the Junction, and Yampa Mountain Upthrusts.

Brown's Park Group, and reach Yampa Mountain, which rises directly upon that axis, as does Junction Mountain. Here we find that the description that has just been given of the Junction Mountain upthrust will apply in all essential respects to this. All around the base of Yampa Mountain the strata of the Brown's Park Group cover the immediate borders of this upthrust, even to a greater extent than they do those of Junction Mountain upthrust; but it is readily seen that the two mountains are essentially identical in structure and character, and that they have been produce in a similar manner. Yampa upthrust, however, is smaller than the other, and it is also much farther away from any other greatly displaced strata. Its outline is oval, the longer diameter, including all the strata involved,—not much exceeding seven miles in length,—and its shorter diameter is less than four miles. The longer diameter is nearly at right angles with that of Junction Mountain upthrust, and it is nearly transverse with the inceptive portion of the Uinta axis, upon which it rises. The relation of these two upthrusts to each other and to the main and inceptive portions of the Uinta fold is indicated by the section, Fig. 3.

a, Yampa Mountain; b, Junction Mountain; c, eastern end of the Uinta Range; d, Yampa River, before entering Junction Mountain; e, Snake River; U., Uinta Sandstone; Carb., Carboniferous strata; J. T., Jura-Trias; D., Dakota Group; Col., Colorado Group; B. P., Brown's Park Group.

Horizontal scale: 5 miles to the inch.

Vertical scale: 1-20 inch to 1,000 feet.

The amount of vertical displacement is about the same in each of these upthrusts, the extent of which is estimated from the thickness of the formations (as given in the foregoing table) and from the contour lines on the published topographic maps of that

region. The contour line which cuts the top of the Uinta Sandstone in both these mountains passes along the southern side of Axial Basin, approximately at the base of the Laramie and the top of the Fox Hills Group. Referring to the preceding table, we find the thickness of the intervening formations to be eleven thousand eight hundred feet. It is therefore plain that the amount of vertical displacement in both these mountains is not less than is represented by those figures. That is, within the narrow and sharply defined limits that have been described, the strata of which both these mountains are composed have been thrust up a vertical distance of more than two miles,—which in the case of the Yampa upthrust is nearly equal to one-third of the longer diameter of the area affected by it.

As indicating that the amount of vertical displacement in these upthrusts is really greater than has been mentioned, it may be stated that the Fox Hills and Laramie strata referred to have themselves been elevated to a considerable extent in the adjacent Danforth Hills uplift (as shown by the section, Fig. 2). This figure will also serve to illustrate the relation of the Yampa upthrust to the inceptive fold and to the adjacent Danforth Hills uplift. That is, if within the space indicated by the length of the line xx the strata should be elevated until the base of the Carboniferous series reaches the place of the uppermost dotted line, the vertical extent and lateral restriction of the Yampa upthrust will be indicated.

It is true that the vertical displacement in the case of these two upthrusts is much less in amount than is that of the great fold; but the amount of displacement is far more remarkable in the case of the upthrusts than it is in the case of the fold, because of the very narrow limits within which the displacements in the former case have taken place. The narrow and sharply defined limits of these upthrusts, and the severing of the displaced portions of the formations from the great mass of each respectively, with little or no general disturbance of the latter beyond those limits, may be compared to the action of a large punch on being forced by great power through a number of thick iron plates. The comparison will be more complete if we conceive that the cutting-border of such a punch had become dulled at certain places, so that a part of the iron through which it was being forced would drag and not be sharply severed. Portions of the uplifted strata at the base of both these mountains

seem to have thus dragged during their elevation; while other portions were sharply severed, as if the displacement had really been done by a huge punch acting from beneath, producing an ordinary fault there.

The evidence that the orogenic and epirogenic movements which have resulted in the present physical conditions in the Western portion of our national domain were coëval with each other, seems to be unmistakable, so far, at least, as the time-limit of each series of movements is concerned. But, considering for the present only the orogenic movements, it is evident that the uplifting force has been applied along certain lines with great inequality, both as regards the amount of force locally exerted and the duration of its application. That is, in the region especially referred to in this article there are indications that while the orogenic displacements now observable there were in progress there were local arrests and accelerations of the elevating movement, which produced a final diversity among them that did not exist in their inception.[1]

For example, the present structural condition of the Uinta fold seems to warrant the assumption that it was once, along its entire length, in the condition in which its inceptive portion now is, except for the presence of the upthrusts. Furthermore, that these upthrusts, as well as the main portion of the fold, continued their upward progress, while the present inceptive portion remained as it was when its elevation was arrested. There are other plain indications of the arrest and acceleration of uplifting force in that region; but the upthrusts rising upon the inceptive fold constitute the most striking examples.

The elevating force was not only strangely concentrated in the case of the two upthrusts, but it seems to have been applied in an unusual manner, especially when we consider the position of the longer axis of each with relation to that of the other, and also to that of the Uinta fold. It has been mentioned that the longer axis of the Junction upthrust lies in a northwest and southeast direction, and that of the Yampa upthrust in a northeast and southwest direction. Viewing these upthrusts only in relation to the Uinta fold proper, and regarding them as nearly or quite isolated portions of the same, one would naturally expect to find their longer axes coinciding with a line projected from the axis of the main fold, and he would also expect to find the intervening strata along that line to

have partaken largely in the upward movement. That is, in view of the simplicity of the main portion of the Uinta fold, one might naturally expect that the uplifting force which was applied along its entire axis would have acted strongly and continuously, if not uniformly. But the foregoing statements show that neither of the upthrust axes coincide with such a line or with each other, and also that only a comparatively slight elevation of the strata has occurred along what I have designated as the inceptive portion of the Uinta fold.

These upthrusts are so extraordinary in their character that one instinctively desires to know how they were produced. I freely admit my inability to reply to such an inquiry in a satisfactory manner; and for the present I will offer only the following suggestion. Assuming—as the evidence seems to warrant us in doing—that the completion of the main Uinta fold and that of the Park Range were contemporaneous, or nearly so, they constituted ponderous buttresses at either end of the strongly-curved inceptive portion of the Uinta fold. It is not strange, therefore, that any elevating force that may have been applied along the axis of that inceptive fold—which stretched across the intervening space—should have been diversely, if not abnormally, applied.

NOTES ON THE GEOLOGY OF JOHNSON COUNTY, IOWA.

BY CLEMENT L. WEBSTER.[1]

THE superficial geology, or the study of the nature, origin, and distribution of the loose materials, or superficial detritus commonly denominated loess, drift, and aluvium, constitutes one of the most interesting as well as important fields for study that fall within the scope of investigation of the geologist.

The interpretation of the phenomena of the glacial period, the cause of the advance and retreat of the ice sheets, the condition of the climate and of the fauna and flora of the surface (now covered by drift) during the interglacial time, the extent and condition of

[1]State University, Iowa.

PLATE V.

POT HOLE, NO. 2.

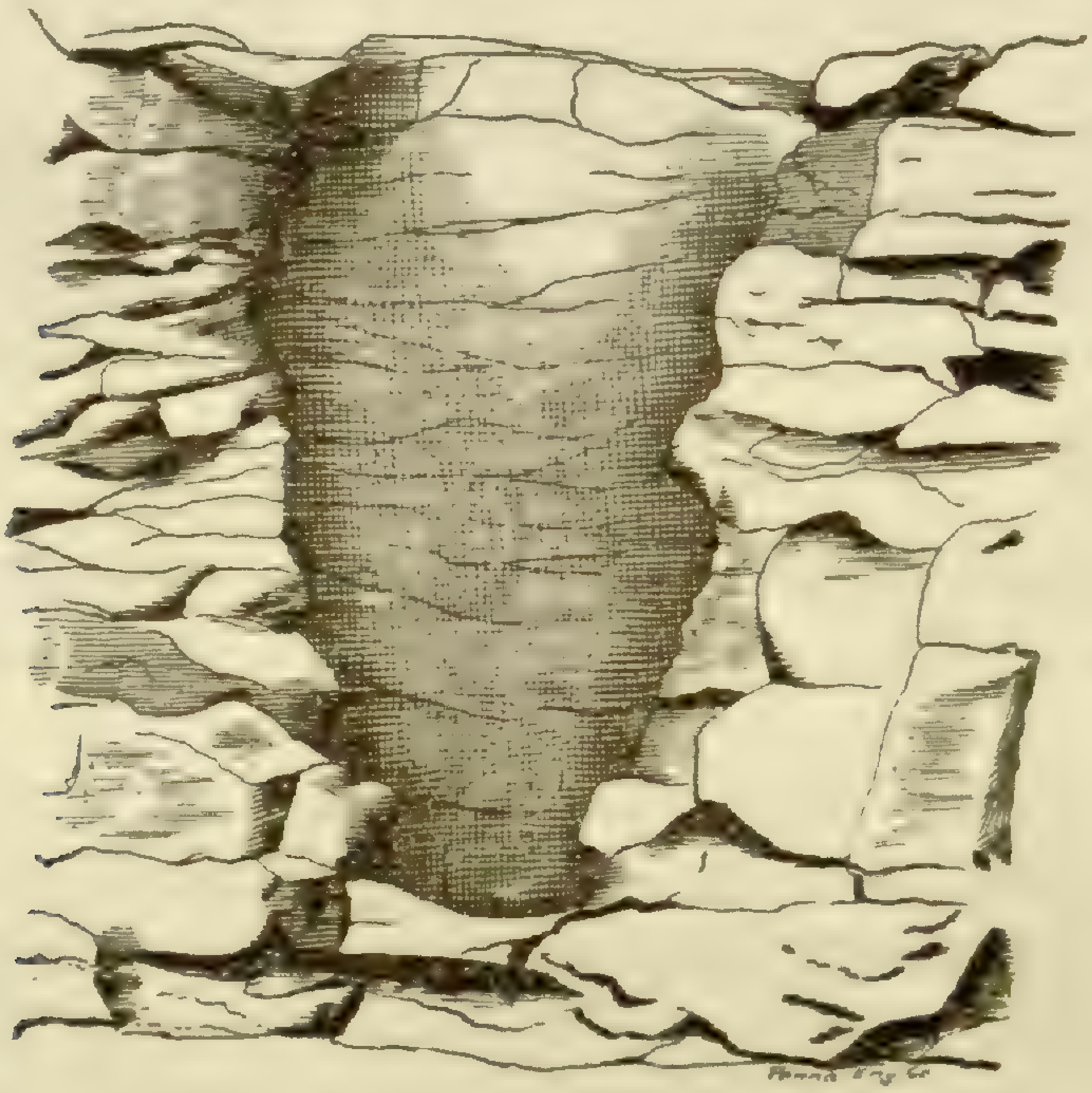
the preglacial river channels which have become obliterated, at least in part, and the condition of things during the Champlain period, are all subjects of the most profound interest to the geologist.

In this paper I have endeavored to elucidate some of these phenomena as observed in Iowa, and it is hoped that it may not be without at least some value to the broad field of science.

In the hard Devonian limestone in the west bank of the Iowa River, at Iowa City, are numerous (often large) very interesting potholes, which have been formed by the action of running water; and as they shed so much light upon the condition of things at this locality at the beginning of the Carboniferous age, a short description of a few of the more prominent ones here is deemed not to be without interest and value.

The rocks in which these potholes are formed, rises to a height of from twenty to forty feet above the water in the Iowa River.

Pothole number one: Circular, sides smooth and symmetrical, sloping gradually to the bottom, upper margin rounded, depth five feet, diameter at the top two feet, and at the bottom one foot.



Pothole No. 1.

The following diagram will illustrate this description:—

One foot from this is another smaller subcircular pothole, having a depth of two feet and a diameter at the top of one foot, and at the

bottom of ten inches, with unsymmetrical but smooth sides; upper margin smooth and somewhat flaring.

About half way from the top to the bottom, cavities have been formed in the sides by the action of the water which formed the pothole. The upper margin of this pothole has a small channel cut through to the east, apparently by the overflow.

Pothole number two: This is one of the largest and most interesting examples to be found here. This pothole has been formed by the union of several minor ones. Its longest diameter is from east to west, somewhat subovate in marginal outline, sides unsymmetrical but smooth, more or less gently sloping to the bottom, upper margins unevenly rounded, depth seven feet, length from east to west seven feet, and width of the eastern portion at the top two and one-half feet, and marginal width of the western portion four and one-half feet, contracting at the bottom to a width of two and one-half feet.

In the west side of this pothole, about midway from top to bottom, large, more or less ramifying cavities, varying from three feet to eight feet in extent, have been worn by the action of the water which formed the pothole. The overflow to the east has cut a channel about three feet in depth and two feeet in width. About four feet to the right of the foregoing is a small bowl-shaped depression, with smooth symmetrical sides, and rounded or flaring margin. Near this is another smaller saucer-shaped depression, having a diameter of sixteen inches, and a depth of six inches. These are beautiful examples of how some of these potholes were begun.

The following cut (from a photograph) will illustrate the form and position of these depressions in relation to the large pothole above described:—

Pothole number three: Subcircular in outline, sides somewhat irregular, smooth, upper margin slightly flaring. For the first four feet the sides are nearly perpendicular; below this point the hole rapidly enlarges to the east, but soon contracts, and continues its downward course in the form of a gradually-narrowing oblique fissure, that finally unites with a rather large, more or less horizontal, crevice between the beds of rock.[1]

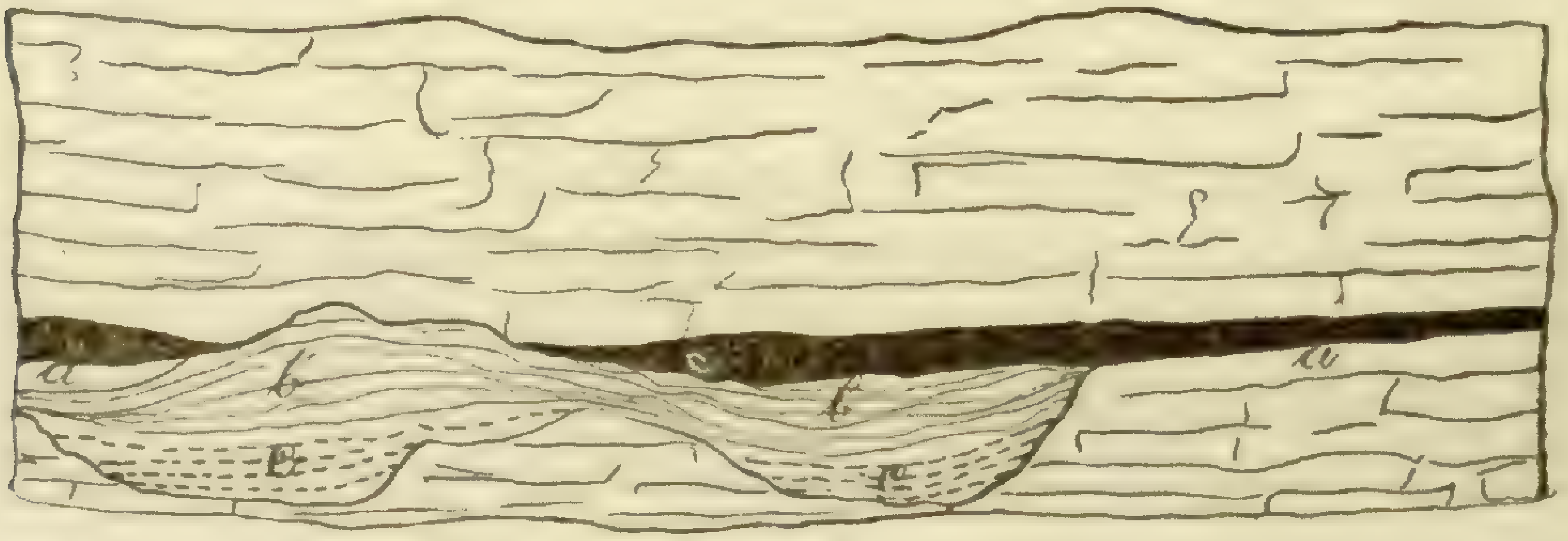
[1] This fissure is filled with a black, combustible, carbonaceous mud of bituminous matter, which is usually underlayed and sometimes overlayed by a reddish-brown clay.

The following diagram will illustrate this description :—

Pothole number four : This is the largest and deepest of any yet

Pothole No. 3. *a a*, coal seam.

observed, having a depth of slightly upward of fourteen feet. Although much of the rock in which this pothole was formed has



a a, coal seam; the lower part shaly and containing fish teeth; *b b*, ash-colored and greenish underclay; *c c*, coarse sandstone in curved laminæ.

been removed by quarrying, yet enough of the excavation itself remains to demonstrate the fact that it was formed by the enlarge-

ment of a deep vertical fissure. In this same rock are numerous other minor potholes of much interest, many of them showing unmistakable evidence of having originated in a larger or smaller vertical fissure, their upper margins being invariably rounded, or more or less strongly flaring, with often a larger or smaller channel cut through to the east by the overflow, thus demonstrating the fact that the flow of water which formed them was from the west. Many of these potholes are filled (and all showing evidence of having been originally) with a hard, stiff, reddish-brown, sometimes brownish-black, clay, similar to the underclay of coal seams. Not only are these potholes filled by this clay, but also the numerous vertical and horizontal fissures and spaces between the rock bedding filled with the same material. This reddish-brown color, however, is probably due to the infiltration from the, in places, very ferruginous drift material, which immediately overlies them.

About thirty years ago, during the geological survey of Iowa by James Hall, important facts (since mostly obliterated by the extensive quarrying of the rock) were observed in regard to this phenomena; and for the sake of greater clearness in the matter, I here give a partial compilation of the description of it as found in the survey:—[1]

"In a cliff of limestone of the Hamilton Group, at Iowa City, the following phenomena is observed:—

"Beneath beds of nearly horizontal limestone appears a black band extending thirty or forty feet: this consists of black carbonaceous mud, the upper part having the character of cannel coal, and the lower part a slaty carbonaceous shale.

"Beneath this, and less extended, a thicker layer of greenish-grey clay, of the character of underclay of coal seams, fills the upper and broader part of the cavity; while below this, and occupying the deepest parts, is a coarse sandstone, which follows, in its line of lamination, the curvature of the limestone upon which it lies."

This description is illustrated by the following diagram:—

"Here we have all the phenomena attending a true coal-measure seam of coal: the sandstone, the underclay, and the coal seam resting upon it; and to complete the analogy, the slaty portion of the seam contains *fish teeth* of carboniferous character. All this is

[1] Hall's Geological Survey of Iowa, Vol. I., Part 1, pp. 129–133 and 265.

enclosed in limestone, which, in the State of New York, where the series is more complete, lies at a depth of more than five thousand feet below the coal measures."

The result of the most critical examination and study of the phenomena as observed to-day, is such as to corroborate the statement then made in regard to this subject, which is as follows:—

"The coarse and fine sand were first transported, and, entering some fissure [probably a pothole] in the rock, continued in deposition in this cavity, while a bed of similar sandstone was being formed outside upon the bottom of the sea. This ceased, and then came the clay, which continued in like manner, while the under clay of an exterior coal bed was in process of deposition.

"Lastly, the carboniferous mud, derived from the material of a coal seam, was filtered through the fissure, filling the remaining space, and spread out in the narrow seam beyond. There is no mingling of the material, as if resulting from the breaking up of a coal seam at a later and modern period.

"Every part is as distinct as in the coal measures elsewhere; and this only could have resulted from a participation in the cause then operating to produce those extensive beds of sand, shale, clay, and coal which make up the coal measures. This point is near the northeast margin of the coal basin, and beyond the limits of any productive coal seams; a few isolated patches of sandstone and shale being all the remaining evidence of the extension of the series in that vicinity."

It is believed that the immediate valley or channel of the Iowa River, from Coalville to Iowa City, and perhaps north from this point, in Johnson County, represents the channel of an old Devonian stream.

Occupying a position in the east side of the valley of the Iowa River, where an abrupt curve is made, near Iowa City, is a patch of soft, friable carboniferous sandstone, having a length of one-fourth of a mile, and a breadth of one-eighth of a mile or less. This sandstone occupies a valley of erosion in the Devonian limestone, and which has a depth of between thirty and forty feet. That this was a valley of erosion, formed by the action of flowing water prior to the time when the sandstone was deposited, is obvious, as the sides of this valley are seen, after the removal of the sandstone, to be smoothed and worn by the long-continued action of running water.

The channel of the Iowa River, from Iowa City north, in this county, has been eroded to a depth of from twenty feet to upwards of one hundred feet into the hard Devonian limestone. As I have before intimated, it is believed that this valley was formed, to a great extent at least, by an old Devonian stream, and then subsequently filled by the sandstone during the Carboniferous age.

The glacial drift in Johnson County, so far as it has been observed, is everywhere covered by a profound mantle of loess, so that it can be observed only along the borders of streams, and along the axis of surface drainage, where the overlying formation has been cut through, thus exposing the drift at the bottom. This formation, so far as can be made out, attains a thickness of from four feet to eighteen feet, and is composed of clay, sand, gravel, and boulders. The boulders, however, are rarely observed, except at the bottom of ravines, where they are sometimes quite numerous, and vary in weight from ten pounds to upwards of two thousand pounds. The drift, for the most part, shows but slight evidence of modification or rearrangement of its materials. In some places, however it contains an abundance of ferruginous matter, so much indeed as to give it, at limited localities, a deep-red color. The gravel of this formation is made up of more or less rounded fragments of Devonian limestone, derived from the subjacent strata, smoothed and well rounded, often beautiful striated, pebbles of granite, quartz, trap, greenstone, and others of igneous origin, which have been derived from the north. The boulders are also of the same material and origin with the exception of those of Sioux quartzite, which were derived from the northwestern portion of the State. Devonian fossils (and rarely Carboniferous), derived from the underlying rock, are also common. The old forest bed is also well represented, and occupies, as is usual throughout other portions of the State, a low horizon in the drift formation.

While digging a well on the farm of Mr. Joseph Hedger, about five miles southeast from Iowa City, the forest bed was struck at a depth of about twenty-eight feet. This formation was represented by a dark-brown, slightly-combustible peat formation, which was overlayed by, and slightly mixed with, a layer of coniferous wood and twigs. This peat also contained abundant remains of plants, well-preserved seeds (apparently those of grass), and abundant remains of Coleopterous insects. This bed rests directly upon hard,

stiff, distinctly stratified blue clay. This formation has been struck at numerous localities at a depth of from twenty-eight feet to sixty feet below the surface, in the central portion of this county. A usual feature of the peat division of the forest bed of this region are the remains of Coleopterous insects. The peat at all these localities was evidently formed where it is now found, and are parts of one and the same bed.

A limited deposit of similar ancient peat was also discovered in Adair County, one hundred and seventy miles to the westward of Iowa City, on section twenty-two, township seventy-five, range thirty-two. This bed was found to be between two and three feet in thickness. The drift, apparently only slightly if at all modified, rested directly upon it, and it was underlayed by a dull, bluish-clayey bed.

At another locality, near Davenport, fifty miles east of Iowa City, a deposit of peat occurs almost upon the very brow of the bluffs that border the valley of the Mississippi. This example is one of unusual interest, in consequence of the existence there of an extensive bed of ancient peat which is covered to th lepth of several feet beneath the prairie soil, and the discovery in the clay, above the peat, of the remains of a mammoth.

The following section, compiled from White's *Geological Survey of Iowa*, vol I., part i., pp. 119, 120, will show the position of the deposit in relation to the drift :—

"No. 1. The ordinary prairie soil, one foot. The prairie here extends to the edge of the bluff, gently sloping backward toward the north.

"No. 2. The 'yellow clay' or loam, twenty feet thick, iron-stained, frequently distinctly laminated; laminæ curved, and have their layers of sand interstratified in some places. It contains small calcareous nodules and shells of the genera *Succinea, Helicina* and *Pupa*.

"No. 3. Bluish-grey clay, three to five feet thick, not stratified; contains a few shells like those of No. 2. A tusk, several teeth, and some other portions of *Elephas primigenius* (?) were found, just at the junction of Nos. 2 and 3.

"No. 4. A bed of brown peat one foot thick, which burns tolerably well. In some places the peat moss, *Hypum aduncum*, was so well preserved as to be recognized. Quantities of much-decomposed coniferous wood are distributed throughout this bed.

"No. 5. Ancient soil, two feet thick, very dark loam, resembling the peat, but more decomposed. Contains no shells or other fossil remains.

"No. 6. Blue clay, very tenacious, containing sand, gravel, and small boulders; pebbles and boulders, all water-worn, and many of them distinctly glacier scratched. Thickness unknown."

"The exposure was made by the excavation of the Chicago, Rock Island and Pacific Railroad Company, previous to which there was no appearance at the surface to indicate the presence of anything more than the ordinary drift deposit."

Bed No. 5 of this series is undoubtedly only a more thoroughly decomposed and finely comminuted portion of bed No. 4. This bed of peat, also, like that at Iowa City, contains remains of Coleopterous insects.

While boring a well on the northeast quarter of section ten, township eighteen, range five, in Linn County, a deposit of peat and coniferous wood four feet in thickness was struck at a depth of ninety-nine feet below the surface. From this well, into which a tight galvanized iron tubing has been forced, escapes a constant supply of natural, combustible gas (the peat probably being the origin of it), but whether of sufficient quantity to be of practical value, is a question to be answered by investigation. A few miles from this locality another well of the same character is reported.

In the northern portion of the State the peat formation is seldom, f ever, observed as a member of the forest bed. These beds of peat are of interglacial origin, and was coexistent with the luxuriant forests of conifers which, in interglacial times, covered the surface of what is now known as Iowa.[1] The occurrence also of the well-preserved seeds of plants and the abundant remains of insects in this formation are features of peculiar interest.

A critical and somewhat extended study of the forest bed and other superficial formations in different portions of the State, reveals facts which seem to substantiate the theory advanced in regard to the relative age of the peat formations.

The topography of the surface of Johnson County is, for the most part, peculiarly that of loess regions, being more or less broken and rolling, the elevations having rounded tops, and more or

[1] These beds of peat were believed by Dr. White not to be of interglacial origin. White's Geological Survey of Iowa, vol. i., p. 121.

less rapidly ascending sides, and rising to a height of from ten feet to upward of sixty feet above the intervening depressions.

The valleys of the Iowa River and its tributaries are relatively narrow and deep, and bordered by more or less steep acclivities, and flanked at frequent intervals by deep but narrow and rapidly ascending ravines, and these again often ramify in shallow depressions which draw the water quite effectually from nearly all portions of the upland.

The immediate valley of the Iowa River, as I have before intimated, attains an average width of one-half of a mile, and a depth below its immediate borders of from sixty feet to upward of one hundred and seventy-five feet. Well-defined terraces are sometimes observed along this stream, and they have been produced by the deepening of the valley by the action of the waters of the stream.

As has been before stated, the surface of nearly, if not quite all of this county, is occupied by a loess formation, which effectually conceals the underlying drift formation, except along the valley-sides and the axis of surface drainage, where the overlying deposit has been cut through. This deposit attains a greater thickness along the streams than adjacent to them, and consists, for the most part, of an exceedingly finely comminuted yellow or buff-colored clayey earth, with an admixture of humus in favorable situations, as in the beds of drainage depressions and in the valleys, as well as most usually the more level surface of the upland, which gives to it a color varying from a light-ash to a deep-black. Upon the higher points, however, the soil usually contains comparatively little humus, for the reason that it is swept down by the rains as fast as it is accumulated by the decay of vegetation, and deposited in the beds of ravines and the slight valley bottoms.

The following section, taken at the "brick-yard," in the northeast portion of Iowa City, gave the following result :—

1. Very fine brownish "loamy" soil, containing humus—three inches.

2. Very fine and homogeneous yellow-clayey earth—fifteen feet.

3. Very fine and homogeneous bluish-grey, clayey earth, having more or less numerous brownish-drab streaks running through it, and containing numerous fossils, many of which were in a crushed condition—five feet. Entire thickness unknown.

The different divisions of this section pass into each other by

very gradual and imperceptible gradations. In a railroad cut, about one and one-fourth miles west of Iowa City, the loess is seen to attain a thickness of twenty-three feet and five inches.

The humus-stained division, No. 1, attains a thickness of five inches; while the second, or yellow division, attains a thickness of about twelve feet; and below this, the third, or blue division, which attains a thickness of eleven feet, and rests immediately upon the drift. This portion contains an abundance of fossils, most of which, however, are in a better preserved condition than those of its equivalent at the "brick-yard."

One mile south of Iowa City the loess is seen to attain a thickness of twenty feet, and is very fine and homogeneous throughout, being of a yellow or yellowish-buff color, with the exception of a humus-stained layer, of a few inches in thickness at the top. The yellow clay at this locality rests directly upon the drift, the blue division being absent, as also fossil remains, so far as observed. At Oxford, in the extreme western portion of the county, the typical yellow loess is seen to have a thickness of from fifteen feet to twenty-two feet, the blue division, however, not being present.

No fossils were observed in the loess in this region. Occupying the same relative position to the loess, and presenting the same general character as at other described localities, is the drift formation. At this locality, as well as several others in the county, the loess is seen to contain more or less extensive accumulations of fine silicious sand; also, at two or three places, I observed small accumulations, or pockets, of well-rounded and smoothed quartz and greenstone pebbles of drift origin. This material may have been derived from detritus ladened ice, floating from the north and dropping its burden while this formation was in process of deposition. At numerous localities the loess contains abundant calcareous concretions and ferruginous tubules of various dimensions, while at other localities it is devoid of them.

At Solon, in the northeast part of the county, the loess is somewhat thinner than at the previously-described localities, but is essentially the same, although the lower, blue, division is not noticed, and the upper, black, humus-stained layer, is somewhat thicker, owing to the somewhat less broken surface, and the lessened facility with which the surface is "washed" by rains, thus removing much of the humus accumulated by decomposing vegetation.

Below I give a catalogue of all the fossils yet obtained from the loess of Johnson County; doubtless, however, many others existed which have not as yet been discovered.[1] Those marked * do not occur as living forms in the county at the present time:—

Zonites viridulus (Mke.).
Zonites limatulus * (Ward).
Zonites fulvus (Drap.).
Patula strigosa * (Gld.).
Patula striatella (Say).
Ferussacia subcylindrica (L.).
Pupa muscorum * (L.).
Pupa blandi * (Mone.).
Vertigo simplex * (Gld.).
Mesodon multilineata (Say).
Vallonia pulchella (Müll.).
Succinea avara (Say).
Succinea avara var vermeta,—
Succinea obliqua (Say).
Helicina occulta (Say).
Limnæa desidiosa (Say).
Physa—sp. (?)
Pisidium—sp. (?)

Egg-shell of some small *Helix*.

The loess formation constitutes a prominent feature of the superficial geology of Iowa, being developed to a greater or less extent over a large portion of the State. It is believed that the material of this formation was deposited during the Champlain period; and facts seem to demonstrate, moreover, that this was not only a period of somewhat lower level in Iowa as well as other places, than the present, but also that the amount of depression increased somewhat to the northward, so that the streams flowing to the southward had usually a diminished slope, with a consequently slackened flow of the waters, and many greater or less expansions along their course, and from these silt-ladened waters the material of the loess formation was derived.

[1] For this catalogue of species I am much indebted to Professor B. Shimick, of Iowa City. All the species listed have been personally collected by him.

HISTORY OF GARDEN VEGETABLES.

BY LOUIS STURTEVANT, M.D.

(Continued from page 985, Vol. XXI.)

Fennel. *Fœniculum vulgare* Gærtn.

FENNEL was used by the ancient Romans, as well for its aromatic fruits as for its edible succulent shoots. It was also employed in Northern Europe at a remote period, as it is constantly mentioned in the Anglo-Saxon medical receipts which date as early at least as the eleventh century. The diffusion of the plant in Central Europe was stimulated by Charlemagne, who enjoined its cultivation on the imperial farms. Fennel shoots, fennel water, and fennel seed, are all mentioned in an ancient record of Spanish agriculture of 961 A.D.[1] There are three different forms recognized, all believed to belong to a common species, *Fœniculum vulgare* Gærtn., but which have received specific names by various botanists.

Bitter Fennel. *F. vulgare* Gærtn.

In 1863, Burr describes[2] a common and a dark-leaved form; in 1586, Lyte's[3] Dodœns describes in like manner two varieties. This is the common wild sort, hardy, and often spontaneous as an escape from gardens. It is the *Anethum fœniculum* L., 1763, and the *Fœniculum* of Camerarius,[4] 1586. Sometimes, but rarely, the leaves are used for seasoning, and the plant is chiefly grown for its seeds which are largely used in the flavoring of liqueurs.

The *common* or *bitter fennel* is called in France *Fenouil amer.*, *Fenouil commun.* It appears to be the *common fennel* or *finckle* of Ray, 1886, the *fœnell* and *fyncle* of Turner, 1538.

Sweet Fennel. *F. officinale* All.

This form is cultivated more frequently as a garden plant than the preceding, and its seeds are also an object of commerce. As the plants grow old, the fruits of each succeeding season gradually

1 Pharmacographia, 1879, 308.
2 Burr. Field and Gard. Veg. of Am., 1863, 420.
3 Lyte's Dodœns, 1586, 305.
4 Camerarius Epit., 1586, 534.

change in shape and diminish in size, till at the end of four or five years they are hardly to be distinguished from those of the bitter fennel. This curious fact was noted by Tabernæmontanus in 1588, and was systematically proven by Guibort, 1869.[1] This kind has, however, remained distinct from an early date. It is described by Albertus Magnus[2] in the thirteenth century, and by Charlemagne in the ninth. It is mentioned as a plant of the garden in nearly all the earlier botanies. It is cultivated throughout Europe, in Asia and in America as an aromatic garden herb.

The famous "carosella," so extensively used in Naples, and scarcely known in any other place, is referred by authors to *F. piperitum* D. C., a species very near to *F. officinale*. The plant is used while in the act of running to bloom; the stems, fresh and tender, and broken and served up raw, still enclosed in the expanded leaf stalks.[3] It is, perhaps, referred to by Amatus Lusitanus[4] in 1554, when, in speaking of the *finocchio* (It.) he says the swollen stalk is collected and said to be eaten, "quod caule turgescente colligitur et esui dicatur."

The *common* or *sweet fennel* or *Roman fennel* is called in France *fenouil doux*, *fenouil de Florence*, *fenouil de Malta*, *anis de France*, *anis de Paris*; in Italy, *carosella*.[5] These names also seem to apply in part to the next kind. In Turkestan, *shabit*.[6]

Finocchio. *F. dulce* D C.

This form is very distinct in its broad leaf-stalks, which, overlapping each other at the base of the stem, form a bulbous enlargement, firm, white and sweet inside. It seems to be the *Finochi* or *Italian Fennel*, stated by Switzer,[7] in 1729, to have but recently been introduced to English culture, and yet rare in 1765;[8] but the first distinct mention I find is by Mawe,[9] in 1778, under the name of *Azorian Dwarf* or *Finocchio*. It is again described in a very

[1] Pharmacographia, l. c.
[2] Albertus Magnus. De Veg., Jessen ed., 1867, 517.
[3] Vilmorin. The Veg. Gard., 1885, 246.
[4] Amatus Lusitanus in Diosc., 1554, 338.
[5] Vilmorin. Les Pl. Pot., 209.
[6] Gard. Chron., July 25, 1885, 109.
[7] Switzer. Meth. for Raising, etc., 1729, vii.
[8] Stevenson. Gard. Kal., 1765, 46.
[9] Mawe. Gard., 1778.

perfect form by Bryant, in 1783,[1] under the name of *Sweet Azorian Fennel.* According to Miller's Dictionary, 1807, it is the *F. azoricum* of Miller, 1737. Ray,[2] in 1686, uses the name *Fœniculum dulce azoricum,* but his description is hardly sufficient. It is described for American gardens in 1806.[3] It does not seem to have entered general culture except in Italy.

The type of this fennel seems to be figured by J. Bauhin in 1651, and Chabræus, in 1677, under the name *Fœniculum rotundum flore albo.*

The Finocchio or Azorean Fennel is called in France *fenouil de Florence, fenouil sucre, fenouil de Bologna, fenouil d'Italie;* in Germany, *grosser susser florentiner Fenchel, grosser bologneser Fenchel, florentiner Anis;* in Holland, *groote zœte Bologneser grosser venkel;* inDenmark, *dvergfennikel;* in Italy, *finocchio dulce.*[4]

The general name for the Fennels is in France *fenouil;* in Germany, *fenchel;* in Flanders and Holland, *venkel;* in Denmark, *fennikel;* in Italy, *finocchio;* in Spain, *hinojo;*[4] in Arabic, *raisniji;*[5] in Egyptian, *savin* or *tshamar hoout;* in Greece, *marathron;* in Hindustani, *owa;*[6] in India, *souf* or *so, ooa;*[7] in Japan, *sen rio, kure no vomo;*[8] in Yemen, *sekamar.*[6]

Fennel-flower. *Nigella sativa* L.

The seeds, on account of their aromatic nature, are employed as a spice in cooking, particularly in Italy and Southern France.[9] It is supposed to be the *gith* of Columella and Pliny, in the first century; of Palladius, in the third, and of Charlemagne, in the ninth.[10] The *melanthion* of Columella, in the first century, seems a descriptive name for his *git.* It finds mention as cultivated in most of the botanies of the sixteenth and seventeenth centuries; is recorded by Vilmorin[11] among plants of the garden, as also by

[1] Bryant. Fl. Diet., 1783, 53.
[2] Ray. Hist., 1686, 458.
[3] McMahon. Am. Gard. Cal., 1806, 199.
[4] Vilmorin. Les Pl. Pot., 209.
[5] Camerarius. Epit., 1586, 534.
[6] Pickering. Ch. Hist., 261.
[7] Speede. Ind. Handb. of Gard., 181.
[8] Thunberg. Jap., 120.
[9] Noisette. Man., 1860, ii., 447.
[10] Fee. Notes to Grandsagne's Pliny, xiii., 244.
[11] Vilmorin. Les Pl. Pot., 1883, 374.

Burr[1] in 1863, and is now found in the lists of some of our seedsmen.[2]

The Fennel-flower,[3] or Roman Coriander, was called, in 1586,[4] by the Moors, *xamin, sunis* or *sunici;* in Italy, *melanthio* or *niella;* in Germany, *schwartz Kummel* or *schwartz Koriander;* in Spain, *neguilla* or *alipurie;* in France, *barbue poyurette* or *nielle.*

The modern names are: in France, *nigelle aromatique, cumin noire, epicerie, gith, graine noire, nielle, quatre-epices, senonge, toute-epice;* in Germany, *Schwartz-kummel, kohm;* in Flanders and Holland, *narduszaad;* in Spain, *nigela aromatica, neguilla;* in Italy, *nigella, comınella, melanzio domestico;* in Greece, *maurokoukatheis maurokoukki.*[5]

In Arab, *shoonez,*[6] *habbah sondeh* (*i.e.*, black seed), *kammoun asouad* (*i.e.*, black cumin);[7] in Bengali, *mugrela;*[6] in Burma, *sa-mung-net;*[5] in Ceylon, *kaloodooroo;* in Egypt, *hub-sindee;* in Hindustani, *kalajira;* in Persia, *siahdaneh;* in Sanscrit, *krishna-jiraka-musavi;*[6] etc.

French Szorzonera. *Picridium vulgare* Desf.

This salad plant is cultivated in Italian gardens, where it is much esteemed.[8] It is also used somewhat in France,[9] and was introduced into England in 1822. It is also of recent introduction into French culture.[10] In the United States it is noted by Burr[11] in 1863. The young leaves are the parts used.

It is called in France *picridie cultivee, cousteline, terra crepie;* in Italy, *caccialepre, terra crepolo.*[12]

Garlic. *Allium sativum* L.

The garlic is believed to be the *skorodon hemeron* of Dioscorides, the *skorodon* of Theophrastus and Aristoteles among the Greeks;

[1] Burr. Field and Gard., Pl. of Am., 1863, 429.
[2] Vick's Cat., 1884.
[3] Vilmorin. The Veg. Gard., 1885, 247.
[4] Camerarius. Epit., 1586, 551.
[5] Pickering. Ch. Hist., 141.
[6] Birdwood. Veg. Prod. of Bomb., 3.
[7] Delile. Fl. Æg., iii.
[8] Hort. Trans., vi., 583.
[9] Bon Jard., 1882, 549.
[10] Noisette. Man., 1860, ii., 422.
[11] Burr. Field and Gard. Veg., 390.
[12] Vilmorin. Les Pl. Plot., 407; Veg. Gard., 515.

the *allium* of Pliny and Palladius among the Romans. Among the Egyptians it was ranked among the gods in taking an oath.[1] On account of its objectionable odor it was avoided in Rome,[2] but it was probably eaten by the common people as now in southern Europe. It is mentioned in the earlier European herbals as in cultivation, and in England, in 1551, by Turner,[3] and in 1548 by Tusser.[4] In Peru, Acosta[5] says, in 1604, that "the Indians esteem garlike above all the rootes of Europe," and in Mexico, even earlier, Peter Martyn,[6] in 1577, noted its presence. It was in the garden of the Choctaw Indians, in North America, before 1775.[7] It is said to have been introduced to China 140–86 B.C.,[8] and to be found noticed in various Chinese treatises of the fifth, sixteenth, seventeenth and eighteenth centuries.[9] Louriero[10] found it under cultivation in Cochinchina. Two varieties are described by Vilmorin[11] in 1883, the common and the pink; and both were in American gardens in 1863.[12]

The garlic is called in France *ail ordinaire, theriaque des paysans;* in Germany, *gewohnlicher knoblauch;* in Flanders, *look;* in Holland, *knoflook;* in Denmark, *huidlog;* in Italy, *aglio;* in Spain, *ajo vulgar;* in Portugal, *alho;*[11] in Russia, *tschesnok;*[4] in Greece, *aglithia, gelgithia, shorton,*[13] *scordon.*[14]

In Arabic, *toum,*[15] *teriac-rowstyan;* in Bengali, *loshoon, lushoona, rushoon;* in Ceylon, *soodooloonoo;*[15] in China, *svon;* in Cochinchina, *cay toi;*[10] in Egypt, *tom;*[16] in India, *luhsun* or *bulbros;*[17] in Malaya, *buvung-pootie;* in Persia, *seer;* in Sanscrit, *mahooshooda;* in Hebrew, *schoum, schumin.*[14]

[1] Wilkinson. Ancient Egyptians, ii., 31.
[2] Unger. U. S. Pat. of Rept., 1859, 334.
[3] Miller's Dict., 1807.
[4] McIntosh. Book of the Gard., ii., 29.
[5] Acosta. Hist. of the Ind., 1604, 261. His first edition, 1590.
[6] P. Martyn. Eden's Hist. of Trav., 1577.
[7] Roman's Nat. Hist. of Fla., 1775, i., 84.
[8] Bretschneider. On the Study, etc., 15.
[9] Bretschneider. Bot. Sin., 78, 59, 83, 85.
[10] Louriero. Fl. Cochinch., 201.
[11] Vilmorin. Les Pl. Pot., 1883, 2.
[12] Burr. Field and Gard. Veg., 1863.
[13] Pickering. Ch. Hist., 145.
[14] Decandolle. Orig. des Pl. Cult., 51.
[15] Delile. Fl. Æg., iii.
[16] Birdwood. Veg. Prod. of Bomb., 249.
[17] Speede Ind. Handb. of Gard., 159.

Gherkin. *Cucumis anguria* L.

This vegetable is described by Marcgrav,[1] in Brazil, in 1648, the name *Cucumis sylvestris Brasileæ* indicating an uncultivated plant. Ten years later Piso[2] described it also as a wild plant of Brazil under the name *guarerva-oba* or *Cucumer asinius,* and gives a figure. It has also been found in the Antilles and continental tropical and sub-tropical America, New Granada and South Florida.[3] It is not mentioned as cultivated in Jamaica, by Sloane,[4] in 1696. Its fruit is mentioned as being used in soups and pickles, apparently gathered from the wild plant, by Long,[5] in 1774, Titford,[6] in 1812, and Lunan,[7] in 1814. It is, however, cultivated in French Guiana and Antiqua.[8] Although described by Ray,[9] in 1686 and 1794, and grown by Miller in his botanic garden in 1755, it yet does not appear as if in the vegetable gardens of England in 1807,[10] although it was known in the gardens of the United States[11] in 1806. In France it was under cultivation in 1824 and 1829,[12] but apparently was abandoned, and was reintroduced by Vilmorin in 1858.[3]

The *small girkin,*[13] *round prickly gherkin,*[11] *West India gherkin,* or *prickly fruited gherkin* is called in France *concombre des antilles, angurie, concombre a spines, C. d'Amerique, C. marron, C. comichon des Antilles, C. arada* (erroneously); in Germany, *west-indische Gurke.*[14]

I do not find mention of any varieties.

Globe Cucumber. *Cucumis prophetarum* L.

The flesh of this cucumber is scanty and too bitter to be edible,

[1] Marcgrav. Hist. Bras., 1648, 44.
[2] Piso. Hist. Bras., 1658, 264.
[3] Naudin. Am. des Sc. Nat., pp. 8, p. 12.
[4] Sloane. Cat. Jam., 1696, 103.
[5] Long. Jam., 1774, 801.
[6] Titford. Hort. Bot. Am., 1812, 100.
[7] Lunan. Hort. Jam., 1814, i., 254.
[8] Cogniaux. Cucurbitaceæ in D. C. Monog., iii., 501.
[9] Ray. Hist., 1886; Suppl., 1704, 333.
[10] Miller's Dict., 1807.
[11] McMahon. Am. Gard. Cal., 1806, 581.
[12] L'Hort. Fran., 1824; Noisette. Man., 1829, 353.
[13] Fessenden. New Am. Gard., 1828, 52.
[14] Vilmorin. Les Pl. Pot., 166.

says Vilmorin,[1] who includes it among the plants of the kitchen garden. Burr[2] says the plant is sometimes eaten boiled, but it is generally pickled in its green state, like the common cucumber, and adds that it is not worthy of cultivation.

Good King Henry. *Chenopodium Bonus-Henricus* L.

The leaves are eaten as a spinage. The plant is now but rarely cultivated. Gerarde speaks of it in 1597 as a wild plant only, while Ray in 1686 refers to it as frequently among vegetables, and Bryant in 1783 says formerly cultivated in English gardens, but of late neglected, although certainly of sufficient merit. In 1807 Miller's Dictionary says it is generally in gardens about Boston, in Lincolnshire, and is there preferred to spinage. It cannot have ever received very general culture, as it is only indicated as a wayside plant by Tragus, 1552; Lobel, 1570 and 1576; Camerarius, 1586; Dalechampius, 1587; Matthiolus, 1598; Chabræus, 1677, etc. Its value as an antiscorbutic finds recognition in its names, *Bonus-Henricus* and *tota bona*.

It is called in English, *Good King Henry*, *Fat-hen*,[3] *English mercury*, *All Good*,[4] *Wild* or *perennial spinage*,[5] *goose foot;* in France, *anserine bon-henri*, *bon-henry*, *epinard sauvage*, *patte d'oie triangulaire*, *sarron*, *serron;* in Germany, *gemeiner Gansefuss;* in Flanders and Holland, *ganzevoet;* in Italy, *bono enries*.[6]

It is recorded for American culture by Burr in 1863, and has now become naturalized about dwellings in a few localities. I have never observed it growing.

Gourd. *Lagenaria vulgaris* Ser.

See under Squash.

It is generally supposed that the Gourd is uneatable. This is true of some varieties, but not of others. Duchesne,[7] in France, speaks of the *trompette gourd* as edible. In ancient Rome recipes for cooking are given by Apicius,[8] and Pliny[9] speaks of their

[1] Vilmorin. The Veg. Gard., 1885, 227.
[2] Burr. Field and Gard. Veg., 1863, 179.
[3] Johnson. Useful Pl. of Gt. Brit., 216.
[4] Bryant. Fl. Dict., 1783, 62.
[5] McIntosh. Book of the Gard., ii., 137.
[6] Vilmorin. Les Pl. Pot., 1883, 9.
[7] Duchesne. Quoted by Decandolle. Geog. Bot., 898.
[8] Apicius. Lib. iii., c. 4, 7.
[9] Pliny. Lib. xix., c. 24.

being eaten, as does also Albertus Magnus,[1] in the thirteenth century. Cardanus,[2] in 1556, says the oblong gourd is edible, and J. Bauhin,[3] in 1651, says the same for two varieties. In India the gourd is said to be eaten, by Drury,[4] Firminger[5] and others; in China, by Smith;[6] in Cochinchina, by Loureiro;[7] in Egypt, by Forskal;[8] in Turkey, by Walsh,[9] etc.

A variety is in edible use in Japan, as I am informed by Mr. Tamari, and of which I have seen the drawings. In Mexico, a variety, as I am informed by Dr. Edward Palmer, is used to form a preserve known by the name of "angels' hairs," from the fibrous nature of the interior portion which is used.

Great-headed Garlic. *Allium ampeloprasum* L.

A mild plant, common in the countries bordering on the Mediterranean, especially in Algeria, and believed to be the native form of the cultivated Leek.[10] In 1568 Camerarius[11] speaks of it as cultivated in gardens, but this is not confirmed as a common course by the references in the *Adversaria*, 1570;[12] in Lobel's observations, 1576;[13] by Dalechamp, in 1587;[14] by Clusius, 1601;[15] by Dodonæus, 1616;[16] these authors referring to it only as a wild plant of the vineyards. In 1882, the *Bon Jardinier* says the country people of Southern Europe eat it raw, and this is the only known use. It is, however, included among garden esculents by Burr,[17] in 1863, and by Vilmorin,[18] in 1883. The description which has come down to

[1] Albertus Magnus. De Veg., Jessen ed., 1867, 499.
[2] Cardanus. De Rerum Varietate, 1556. 222.
[3] J. Bauhin. Hist., ii., 214, 217.
[4] Drury. Useful Pl. of Ind.
[5] Firminger. Gard. in Ind., 126.
[6] Smith. Mat. Med. of China, 128.
[7] Loureiro. Fl. Cochinch., 592.
[8] Forskal. Fl. Ægypt. Arab., 167.
[9] Walsh. Hort. Trans., vi, 56.
[10] Decandolle. Orig. des Pl. Cult., 81.
[11] Camerarius. Hort., 1588, 131.
[12] Pena and Lobel. Adv., 1570, 58.
[13] Lobel. Obs., 1576, 79.
[14] Hist. Gen. Lugd., 1587, 1549.
[15] Clusius. Hist., 1601, 190.
[16] Dodonæus. Pempt., 1616, 690.
[17] Burr. Field and Gard. Veg. of Am., 1863, 124.
[18] Vilmorin. Les Pl. Pot., 1883, 3.

us of the *ulpicum* of the Romans seems to indicate this plant. Columella[1] and Pliny[2] both say it is larger than the garlic; Columella, that the bulb is composed of many cloves, and that it is particularly loud-smelling. Vegetius[3] calls it the *Beticum ulpicum* or *Andulasian ulpicum.* Cato[4] speaks of its use in veterinary practice. Palladius[5] gives minute directions for its culture. If, however, cultivated in Italy, it seems not to have extended its area, but to have disappeared in later times, perhaps superseded by the leek.

The *great-headed garlic* is called in France *ail d'orient, ail a cheval, pourrat, pourriole;* in Germany, *pferde-knoblauch;* in Italy, *porrandello.*

Chabræus, 1677,[6] gives for names: German, *aberlauch, acker-knoblauch;* in France, *ail pourreau;* in Italy, *aglioporro.*

The synonymy in part is as follows:—

Scorodoprasum sive alliporrum. Adv., 1570, 58.
Scorodoprasum. Lob. obs., 1576, 79. Chabr., 1677, 201.
Scorodoprasum alterum. Lugd., 1587, 1549.
Porrum Indum. Cam. hort., 1588, 131.
Scorodoprason I. Clus. hist., 1601, 190.
Ampeloprasum primum. Dod., 1616, 690.
Scorodoprasum dictum J. B. Ray, 1688, 1121.
Allium ampeloprasum. Lin. sp., 1763.
Great round-headed garlic. Mill. dict., 1807.
Great-headed garlic.

Ground-nut. *Apios tuberosa* Mœnch.

This plant, a native of North America, and common in moist thickets, is included by Vilmorin among the plants of the kitchen garden, and worthy of trial. It is hence liable to appear at any time into American culture. The edible portions are the tuberous enlargements borne on the roots, and of the size of an egg or larger; these tubers are starchy, often of an agreeable flavor, and may be eaten like the potato.

In the colonial period the tubers of the wild plant were a

[1] Columella. Lib. xi., c. 3; lib. x., c. 112.
[2] Pliny. Lib. xix., c. 34.
[3] Vegetius. Lib. i., c. 18.
[4] Cato. C. 71.
[5] Palladius. Lib. xii., c. 6.
[6] Chabræus. Ic. et Sciag., 1677, 201.

resource against starvation. Thus Parkman[1] records that Biencourt and his followers at Port Royal, in 1613, were scattered about the woods and shores digging ground-nuts; and the Pilgrims during their first winter were enforced to live on them.[2] This plant was described and figured by Cornutus[3] in 1635, and is described by Clayton[4] in 1739. Although probably grown by Cornutus at Paris prior to 1635, yet it received no further attention until again grown in 1849,[5] and should it gain a foot-hold, its introduction would be scored to this latter date.

J. Hammond Trumbull thinks the *openauk* of Hariot,[6] found in Virginia in 1584, to be this plant, "a kind of root of round form, some of the bigness of walnuts, some far greater, which are found in moist and marish grounds, growing many together one by another in ropes, or as though they were fastened with a string. Being boiled or sodden, they are very good meate." Brereton,[7] in his account of Gosnold's voyage to New England in 1602, notes the "great store of ground-nuts" found on all the Elizabeth Islands. They grow "forty together on a string, some of them as big as a hen's egg." Champlain,[8] 1605–6, observed that the Indians about Nauset harbor probably had "force des racines qu'els cultivent, lorsquelles ont le gout d'artichaut," and it is to these roots that Lescarbot[9] alludes, west and south of Maine, "grosses comme naveux, tres excellentes a manger, ayans un gout retirant aux cardes, mais plus agreable, lesquelles plantus multiplient en telle facon que c'est merveille."[10] Kalm,[11] at a later period, 1749, states that it grows in the meadows along the Delaware, and the roots eaten by the Indians. He adds that the Swedish colonists eat them for want of bread, and that some of the English still eat them instead of potatoes.

[1] Pioneers of France, 274.
[2] Young. Chron. of the Pilg., 329.
[3] Cornutus. Canad. Plant. Hist., 1635, 200.
[4] Gronovius. Virg., 1762, 107.
[5] Heuze. Les Pl. Alim., ii., 548.
[6] Heriot. Hakl. Voy., iii.
[7] Brereton. Purchas., 1651, iv.
[8] Champlain. Voy., 1632, 84.
[9] Lescarbot. Hist. de la Nouv. France, 1612, 840.
[10] All quoted from Gray and Trumbull, Am. Jour. of Sc., May, 1877, 350, i.
[11] Kalm. Trav., 1770–1, ii., 96.

The Indian and other names that have been applied to this plant are as follows:—

English, *Ground-nuts*, Winslow,[1] *Wild Bean;* French of the western prairies, *pomme de terre;*[2] Carolina Indians, *scherzo;*[3] New Jersey Indians, *hopmiss* or *hopniss;*[4] Osage Indians, *taux;*[3] Sioux Indians, *modo;*[5] Virginia Indians, *openauk.*[5]

Hedgehog. *Onobrychis cristagalli* Lamk.

This singular plant is grown in vegetable gardens as a curiosity, on account of the peculiar shape of the seed pods. It has no utility. Its seed appears in some of our seedsmen's lists.

The *hedgehog* or *cockscomb sanfoin* is called in France *herrisson;* in Germany, *igel.*[6]

Hop. *Humulus lupulus* L.

As a garden plant the hop is nearly unknown in this country. In Belgium, however, the young shoots of the plant, just as they emerge from the ground, are used as an asparagus, and the plant is enumerated by Vilmorin among kitchen vegetables.[7] The plant is found in a wild state throughout all Europe, and extends also to the Caucasus, the south Caspian region, and through central and southern Siberia to the Altai mountains, and has been introduced into North America, Brazil and Australia.[8] As a plant for producing hops to be used in the brewing of beer it has long been in use. Hop gardens are mentioned as existing in France and Germany in the eighth and ninth centuries. In America they are noted in Virginia in 1649,[9] and were among the articles sent the Massachusetts company in 1629.[10] The first allusion that I find to the hop as a kitchen herb is by Cobbett,[11] in 1821, but the use of the young shoots is mentioned by Pliny[12] in the first century

[1] Winslow. Young's Chron. of the Pilg., 329.
[2] Dept. of Agr. Rep't, 1870, 405.
[3] Heuze. Les Pl. Alim., ii., 548.
[4] Kalm. Trav., 1770, ii., 96.
[5] Hariot, l. c.
[6] Vilmorin. Les Pl. Pot., 282; The Veg. Gard., 201.
[7] Vilmorin. Les Pl. Pot., 282.
[8] Pharmacographia, 1879, 551.
[9] A Perf. Desc. of Va., 1649, 3.
[10] Mass. Records, i., 24.
[11] Cobbett. Am. Gard., 1821.
[12] Pliny. Lib. xxic., 50.

as collected from the wild plant, rather as a luxury than as a food. Dodonæus,[1] in 1616, refers to the use of the young shoots, as collected apparently from the hop yard, as does also Camerarius,[2] in 1586, and others.

The hop is called in France *houblon;* in Germany, *Hopfen;* in Flanders, *hop;* in Italy, *luppolo;* in Spain, *lupulo, hombrecillos;*[1] in Tartar, *kumalak;* in Hungarian, *comlo;* in Sweden, *humle;* in Denmark, *homle.*[3]

Horehound. *Marrubium vulgare* L.

This plant affords a popular domestic remedy, and seems in this country to be an inmate of the medicinal herb garden only. In Europe the leaves are sometimes employed as a condiment. Although a plant of the old world, it has now secured naturalization in the New World from Canada to Buenos Ayres and Chili, excepting within the tropics.[4] It is figured by Clusius,[5] in 1601, and finds mention by many of the botanists of that period.

Horehound is called in France *marrube blanc;* in Germany, *andorn;* in Italy, *marrubio.*

Pliny[6] refers to the *Marrubium,* among medicinal plants in high esteem, and it finds mention by Columella.[7] Albertus Magnus,[8] in the thirteenth century, also refers to its valuable remedial properties in coughs. We may hence believe tha⁺ as a herb of domestic medicine it has accompanied emigrants into all the cooler portions of the globe.

Horseradish. *Cochlearia armoracia* L.

This plant cannot be identified with certainty with the *Armoracia* of the Romans.[9] If it be the *armoracia* of Palladius,[10] which is a wild plant transferred to the garden, it is very curious that its use

[1] Dodonæus. Pempt., 1616, 609.
[2] Camerarius. Epit., 1586, 934.
[3] Pickering. Ch. Hist., 620.
[4] Decandolle. Geog. Bot., 751.
[5] Clusius. Hist., 1601, ii., 34.
[6] Pliny. Lib. xx., c. 89.
[7] Columella. Lib. x., c. 356.
[8] Albertus Magnus. De Veg., Jessen ed., 1867, 539.
[9] Decandolle. Orig. des Pl. Cult., 27; Pharmacographia, 1879, 71.
[10] Palladius. Lib. iv., c. 9; lib. xi., c. 2; lib. xii., c. 6. Palladius flourished about 210 A.D.

is not mentioned by Apicius,[1] in his work on cookery, of the same century. Zanonius[2] deems the horseradish to be the *draba* of Dioscorides. It seems to be the *raphanus* of Albertus Magnus,[3] who lived in the thirteenth century, and he speaks of the plant as wild and domesticated, but its culture then was probably for medicinal purposes alone, as indicated by him. Its culture in Italy in 1536 is implied by Ruellius[4] under the name *armoracia*, but Castor Durante,[5] in 1617, does not describe it. In Germany its culture as a condimental plant is stated by Fuchsius,[6] in 1542, and by later writers. In 1587 Dalechamp[7] states its culture in Germany, but does not mention it in France. Lyte,[8] in 1586, mentions the wild plant, and its uses as a condiment in England, but does not imply culture; but in 1597 Gerarde[9] states that it is in gardens. It was observed in the gardens of Aleppo by Rauwolf[10] in 1573–5. It was in American gardens previous to 1806,[11] and is now a plant of market garden culture.

Horseradish is a plant of many names. It is called in France *raifort sauvage, cran de Bretagne*, etc., etc.; in Germany, *Meerretig;* in Flanders, *kapucienen mostaard;* in Holland, *peperwortel;* in Denmark, *peberrod;* in Italy, *rafano:* in Spain, *taramago, vagisco;* in Portugal, *rabao de cavalho;*[12] in the north of England, in 1568, *red cole.*[13]

Hyssop. *Hyssopus officinalis* L.

This aromatic plant was formerly in more request than at present Its young shoots and leaves are sometimes used as a condiment, but it rather belongs among medicinal herbs. In 1597 Gerarde[14] fig-

[1] Apicius Cœlius. De Opsoniis, etc., 1709. Apicius flourished about 230 A.D.

[2] Zanonius. Stirp. Hist., 1742, p. 23, t. 15.

[3] Albertus Magnus. De Veg., lib. vi., tract 2, c. 16.

[4] Ruellius. De Nat. Stirp., 1536, 466.

[5] Castor Durante. Herb., 1617.

[6] Fuchsius. De Stirp., 1542, 660.

[7] Hist. Gen. Lugd., 1587, 636.

[8] Lyte. Dodœns, 1586, 688.

[9] Gerarde. Herbal, 1597, 187.

[10] Gronovius. Orient, 80.

[11] McMahon. Am. Gard. Cal., 1806.

[12] Vilmorin. Les Pl. Pot., 1883, 536.

[13] Pharmacographia, 1879, 71. Gerarde. Herb., 1597, 187.

[14] Gerarde. Herb., 1597, 464.

ures three varieties; in 1683 Worlidge[1] names it among culinary herbs in England, but says it is more valued for medicine; in 1778 Mawe[2] describes six varieties, and says generally cultivated in the kitchen garden, and in 1806[3] McMahon includes it in his list of kitchen aromatics for American gardens. It is mentioned among European garden plants by Albertus Magnus[4] in the thirteenth century, and in nearly all the later botanies, Ray[5] enumerating it as also an ornamental plant, in nine varieties. As an ornamental plant is it yet deserving of notice, but its present use in American gardens must be very limited. It is mentioned by Paulus Ægnita,[6] in the seventh century, as a medicinal plant.

Hyssop is called in France *hyssope;* in Germany, *Isop;*[7] in Flanders and Holland, *hijsoop;* in Denmark, *isop;* in Italy, *issopo;* in Spain, *hisopo;* in Arabic, *zoofoe yeabus, ushnaz-daoud.*[8]

EDITORS' TABLE.

EDITORS: E. D. COPE AND J. S. KINGSLEY.

There can be no "privileged classes" among scientific workers. As the exact truth is the object of their labors, personal authority does not exist for them except in so far as the reputation of a man for accuracy will sustain his assertions, where the evidence cannot be obtained from the subject-matter itself. It is dangerous for a man holding a superior place in a scientific laboratory or museum to require subscription to his views on the part of his subordinates apart from their conviction of their truth, since if there be error, it is thus all the more widely advertised, and the hostile criticism is the more general. It is dangerous for subordinates to adopt views on the strength of authority alone, unless means of verification are

[1] Syst. Hort., by J. W. Gent, 1683, 220.
[2] Mawe. Gard., 1778.
[3] McMahon. Am. Gard. Kal., 1806.
[4] Albertus Magnus. De Veg., Jessen ed., 1887, 581.
[5] Ray. Hist., 1686, 516.
[6] Paulus Ægenita. Bruns. ed., 1531, 68.
[7] Vilmorin. Les Pl. Pot., 283.
[8] Birdwood. Veg. Prod. of Bomb., 62.

wanting. Nor has science anything to do with national prejudice. There can be no English, no French, and no German schools. Investigation makes all things even, and credit will be awarded to priority wherever the work be done. But there is another kind of "privilege" which is more insidious, and against this the real producers in the scientific field cannot too fully protect themselves. This is the assumption of credit for work not done, by the appliances of art and other means at the command of wealth. The scientific pretender who introduces names without definitions, or the wealthy man who publishes pictures, and claims to have made scientific discoveries on the strength of the work of an artist only, may make a considerable popular reputation. The man who in ordinary print only, claims discoveries not his own, is easily disposed of; but if he fortify himself with new classical expressions or with good pictures, he produces an impression, even among men of science, who are not familiar with the facts. This is especially true of those publishers who can employ good artists. Such is the effect of a pretty picture on the average naturalist, that one begins to question whether after all science is not a branch of art, and the true scientists are the artists. Of the value of good illustrations we make no question, but that they can set aside analytical scientific descriptions is a proposition that none but some highly "privileged" person can possibly make. Illustrations on a large scale can be furnished but slowly in some parts of the world, owing to their cost; and in other cases owing to the very large amount of material to be figured. In such cases the scientific results cannot be withheld; and descriptions without figures will, and, if they are good, ought to precede the illustrated works. To ignore such work is only the part of indolence; and none but "privileged" persons can afford to be indolent. It has always been the way of this class to enter in and divide the spoil; but science recognizes no proprietary rights. Such persons and their admirers talk grandiloquently of the disinterestedness of the true man of science, and of the sublime indifference to all personal questions which possesses him. But we have always noticed that these very persons resent highly any invasion of their self-assumed privileges; and they are right, in so far as any credit which inheres in them is not granted by others. Scientific, like other men, must live, and their reputation

is the basis of their livelihood. They should then, and in the long run will, refuse to grant especial privileges to either position or wealth, but will expect work to be rewarded by recognition, and will rigorously exclude pretensions based on art or mere nomenclature. This they will do as necessary self-preservation, whenever the tendency may be in an opposite direction.

We regret to read in our esteemed contemporary, the *American Geologist*, an editorial apology for what most scientific men disapprove. We refer to the purchase of the scientific work of a man and the publication of it by the purchaser as though it was his own production. While this kind of a contract is perhaps legal, it is disreputable to the purchaser. A man under necessity for the means of a livelihood may make such a sale of himself without blame; but the man who buys, cannot in this way get a sound scientific reputation. Works of art placed before the public in this way, have been the cause of prosecution of a charge of false pretence against the pseudo-producer. We refer to the Belt case in London, where busts sold as the work of Belt were found to have been purchased by him from the real artist. Belt was mulcted in damages by the court after a trial which attracted much attention. But whatever the law may be, the moral obliquity and intellectual poverty that such a transaction implies on the part of the purchaser, are too plain for dispute.

RECENT LITERATURE.

Baur's Morphogeny of the Carpus and Tarsus of the Vertebrata.[1] — The first portion of Dr. Baur's work upon the above subject deals with the Batrachia, excluding the Salientia; the second will treat of the Sauropsida; the third of the Mammalia. The orders of Batrachia accepted are the Ganocephala of Owen; the Rhachitomi, Embolomeri, and Stegocephala of Cope; the Proteida, Urodela, and Anura. To the Ganocephala belong the most ancient of four-footed vertebrates, but Archegosaurus

[1] Beiträge zur Morphogenie des Carpus und Tarsus der Vertebraten, von Dr. G. Baur. I Theil. Batrachia. Jena, Verlag von Gustav, Fischer.

alone furnishes data for the elucidation of the subject. Like Eryops this genus has five digits on the fore foot. The incomplete remains of this genus lead to the conclusion that the Ganocephala possesses more elements in both carpus and tarsus than are possessed by any other Batrachians (Salamandrella perhaps excepted), and that the carpus was very similar to the tarsus. To the Stegocephala belong the oldest forms of Batrachia, and in these the number of five digits is already usual. The carpus and tarsus of Necturus each consist of six elements in the adult; while in Cryptobranchidæ (Urodela), both in the American and Asiatic species, the carpus has eight, and the tarsus ten elements. The author puts into tabular form the various changes which occur in the number of the tarsal and carpal bones during growth, and gives examples drawn from all the urodelous families, characterizing each primitive element by a letter or number, and tracing the separations and incorporations of each with its neighbors. These tarsal and carpal tables are followed by a table of the number of the digits in various existing and extinct Batrachia. The rudiment of a sixth digit occurs in the Cryptobranchidæ and Amblystomidæ.

Of the three possible modes of origin of the digitated limb (Cheiroterygium): from the fin-form, viz., development from a many-rayed fin; development from a few-rayed fin that has been formed by the obsolescence of the greater part of the rays of a many-rayed fin; and entire sprouting off from a form which had entirely lost its finned extremities. Dr. Baur declares that neither embryology nor palæontology are favorable to the first. All that can be asserted with precision regarding the ancestral form of the Stapedifera is, says our authority, that, since all save strongly modified members of this group have a single bone in the first series of the limbs (humerus, femur), and two bones in the second series (radius, ulna; tibia, fibula), so the ancestral form must also have had a single ray in the first series, and two rays in the second series. If the two rays of the ancestral form ended each in a single ray, the remaining three digits of the pentadactyle extremity must have been developed by sprouting; but if the primitive form possessed five digits, the remaining three must represent the last remains of a many-rayed fin. As facts which seem to lend support to the sprouting theory (already advanced by Bruhl) Dr. Baur instances: (1) the secondary division of the rays of the Ichthyopterygia; (2) a case of the division of the one-rayed fin of Protopterus, noticed by Albrecht; (3) the development and regeneration of the extremities of the Urodela. When the development of the fins of Ceratodus and Protopterus have been studied; when that of such extremities as normally possess two centralia has been worked out; and when the few-toed extremities of Proteus are fully understood, a great step will have been made towards the solution of the problem. The treatise of Dr. Baur is the most complete

review of the subject yet written, and clears the way for future discoveries.—*E. D. C.*

CLAUS'S ZOOLOGY.[1]—The new edition of the "Lehrbuch" of Dr. Claus is much improved over its predecessors, and it stands to-day the best accessible text-book. The illustrations have been increased in number (there are 792), while much new matter has been incorporated in the pages. As in the first edition, the taxonomy of the Vertebrates remains the poorest portion of the work. American authors have been drawn upon, but it is noticeable that the author does not notice the views of Brooks upon the development of Salpa, while a serious error occurs in the text of the Crustacea where Packard's term Paleocarida is used for Nebalia instead of Phyllocarida, which Packard gave to the group. Notwithstanding Bateson's researches, of which no mention is made, Balanoglossus still retains a place near the Echinoderms; in fact, the casual reader would infer from the "make up" that Dr. Claus regarded them as members of the same order as Synapta and Chirodota. The price of the volume (18 marks) is quite reasonable in comparison with that charged for the English translation.

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Brook, George.—Reproduction of Lost Parts in the Lobster.—Notes on the British Species of Zeugopterus. Ext. Proc. Roy. Phys. Soc'y. Edinburgh. 1887.—Note on the Epiblastic Origin of the Segmental Duct in Fishes and Birds. Ext. Proc. Royal Soc'y. Edinburgh. 1887. Both from the author.

Plateau, Felix.—Recherches Experimentales sur la Vision chez les Arthropodes. Ext. Bull. Acad. Roy. Belgique. 1888. From the author.

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[1] Lehrbuch der Zoologie, von Dr. C. Claus. Vierte Auflage. Marburg, 1887.

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GENERAL NOTES.

GEOGRAPHY AND TRAVEL.[1]

ASIA.—INDO-CHINA.—M. de Lanessan, in a paper read before the Commercial Geographical Society of France, gives the area of French Indo-China at about 600,000 square kilometres. The Mekong, though the largest river of the peninsula, passes through a thinly peopled and almost uncultivated region until it enters Cambodia. The principal centres above this point are Luang-Prabang in the north; Nong-Kay, in the southward bend of the Mekong; Lakhone, in the rear of the Annamite provinces of Hatinh and Nghe-An, and largely colonised by Annamites; Bassac, in a navigable reach opposite to the mouth of the Se-Moum, which enters the Mekong from Central Siam; and Tsung-Treng, below the Khong rapids. The lower portion of the Mekong valley, that of the Donai, and the valleys of the numerous small rivers which descend on the eastern side of the mountains that separate Annam from the interior, are rich, cultivated, and well peopled. Tonquin has a veritable winter from October to March, characterised by heavy fogs and fine rain, but farther south the climate changes with the monsoons. Throughout the entire region the mountainous and wooded districts are less healthful than the rice-flats. Roads cannot be said to exist as yet, except immediately around some of the administrative centres. There is a costly railroad, on which as yet not a single car-load of merchandise has passed, from Saigon to Mytho. The Annamites in former times dug many canals, which though for awhile kept up by the French, are now almost entirely abandoned. The Donai is the only river of the region that can be entered by large vessels, and a coral bank obstructs even this. The Bay of Touraine, the port of the province of Quang-Nam, south of Hue, is a safe and ample harbor; and that of Ha-Long, in the north of Tonkin, seems to be equal to it.

According to Mr. McCarthy, Superintendent of Surveys in Siam, two spheres of influence, English and Siamese, are prominent in the Malay peninsula. The inhabitants of the northern portion are Siamese and Chinese, then come the SamSams, a mixture of Malays and Siamese, who are Buddhists and speak a mixed language; then the Malays, who are Mohammedans.

There are also two very curious tribes which are supposed to be aboriginal, called by the Malays "Orang Utann," or wild men,

[1] Edited by W. N. Lockington, Philadelphia, Pa.

and also known as Sakais and Samangs. The Sakai has soft black skin and wool; the Samang has also a very black skin, but the hair is coarse and straight, and the skin is rough. They wear no clothes, are clever in snaring fish and game, and use bows and arrows as well as blow-pipes for weapons.

KURDISTAN.—M. N. Binder recently described his travels in Kurdistan before the French Geographical Society. The name Kurdistan is given by the Turks to a collection of villages in the mountainous district separating Persia from Turkey, between 34° and 40° N. Latitude and 38° and 46° E. Longitude. Lakes Urmiah and Van are situated in the centre of immense table lands, the former, on account of its small depth and the extreme density of its waters, which are six times more saline than sea-water, does not seem to have a great future before it, but the latter lake offers many advantages. M. N. Binder traced the history of the Kurds, and referred to the current tradition that they have French blood in their veins. The variety of religions is the cause of infinite variety among the tribes. The sedentary and nomadic Kurds differ greatly in occupation and mode of life. The Subbas are a strange sect, with a religion composed of a mixture of gnostic and Christian ideas.

THE NEW SIBERIAN ISLANDS.—A recent number of Petermann's *Mitteilungen* contains a map of the new Siberian islands, giving the routes of Dr. Bunge, Baron Toll, Captain de Long, Nordenskiöld, etc. The principal islands are Ostrow Blischnij, Kotelnoi, Faddejewskoi, and East New Siberia.

North of these lie Bennett Land and Sannikow. Remains of the mammoth, narwhal (probably two species), horse, musk-ox, three kinds of deer, hare and seal were found upon the island of Ljachof (Ostrow Blischnij).

THE HITTITES.—It is probable that the renowned Hittite city Carchemish, is to be sought at the site of Jerablûs, from which the British Museum obtained a few years ago most of the Hittite monuments in its collection. The heads sculptured in these Jerablûs monuments are in many cases adorned with a queue or pig-tail identical in shape and position with that worn by the Chinese. The wearers of the pig-tail have Mongolian countenances, and it seems probable that a Mongolian race had obtained the supremacy in some of the Hittite cities.

AFRICA.—THE NIGER.—The French newspaper *Le Temps* contains an account of the voyage of the gunboat Niger from Bammako to Korium, the port of Timbuktu. The journey occupied three months. The Niger left Manambugu (thirty miles below Bammako) on July 1st, and twelve days later reached Diafarabu. Below

this point the country was unexplored, forming part of the States of Tidiani, the chief of Macina.

Bandiagara, Tidiani's capital, is a most important centre of the Mohammedan religion, the town resembling a huge convent. Farther down the river it became difficult to get provisions, since the natives had all retired into the interior. On July 9th, Lake Dheboë was entered, and was found to receive the river Koli-Koli, which waters the province of Formagha. Below Lake Dheboë the Niger takes the name of Bara Issa, and its banks are thickly lined with populous villages. Tidiani had issued strict orders to the Puls and Bambaras to have no communication with the French. The waters are shallow near Timbuktu, so that the gunboat could not proceed to the town. The *djemaa* or associations of merchants have been expelled two years before, and a chief named Rhiaia had been installed by the assistance of the Tuaregs. Knowing the perfidious character of the Tuaregs, the party slept on board every night, and made no excursions into the interior. All negotiations with the chiefs failed, and the Niger returned *via* the Diaka, or western branch of the river, hitherto unexplored. A vast amount of ethnographical and other valuable information was obtained, and a detailed survey of this part of the Niger's course was executed.

Derivation of the Name Congo.—According to Herr Jankó, the name "Congo" is identical with "Songo," and also with "Rongo," and signifies a "spear" in the speech of the Kijangi. The Bakongo were the first people who applied this name to the river, and it is certain that they came from the north and that their language has altered considerably since they separated from their northern progenitors. As it would be easier for a new people to adopt a name already given than to make a new one, it is probable that though in Kijanyi Congo means a spear, in the remainder of the Bantu tongues the word has somewhat changed its original signification, and become a proper name. Bakongo means "a man with a lance," and thus the river name may be interpreted to mean "quick as a lance."

J. Menges' Journey Southward from Kassala.—J. Menges publishes an account (Petermann's *Mitt.*) of his journey between Kassala and the Setit. The very existence of Kassala depends upon the commerce with the countries to the south of it. Two caravan routes conduct southwards. One of these follows the Atbara as far as Tomat, and then crosses the steppe to Kedarif. The second goes directly from Kassala to the Setit, passing by the imposing granite mountain of Kassala.

The people of these regions, belonging to the tribes Homran, Dabaina, and Schukpieh, dwell in the dry season on the borders of

the rivers or in market towns like Kedarif. The character of the three rivers Setit, Atbara and Basalam is everywhere the same; their flood plains are some 90 metres below the barren soil of the plateau, and they are themselves from 120 to 300 metres wide, and about 15 metres deep.

Australia.—Dr. K. V. Lendenfeld (Petermann's *Mitt.*, 1888) states that the influence of forests upon the climate of Australia is the reverse of that which they are supposed to exercise in Europe. While European trees retain much of the water among their roots, the plants of the Australian wastes, including the grasses, Eucalypti and the Spinifex, send their roots to great depths in search of water, and appear to open their stomata only at night.

Dr. Lendenfeld asserts that during his journeys in the interior of New South Wales he has many times travelled all day through forests without seeing grass. The soil, for the most part consisting of red loam, is flat and smooth as asphalt, and hard as stone, forming a marked contrast to that of European forests. When it rains in such a forest the greater part of the water runs off into the hollows at once. As many of these water-holes have a subterranean communication with the sea, no great lakes are formed. The greatest river in Australia, the Murray, is navigable only in winter by flat-bottomed steamboats. In many places where squatters have destroyed the forests the bare soil becomes clothed with so many kinds of grass as to afford subsistence for a thousand sheep where a hundred fed previously.

Mr. S. Brooke (Petermann's *Mitt.*, 1888) describes the recent excursion of himself and his brother in Western Australia, and gives a map of their route. The whole region is lacking in water, yet has numerous plants. The soil is calcareous, with a few mountains and granite rocks rising from the plains. Among these is Mount Rugged, which is about 1,980 feet high and three miles long.

America.—Among valuable maps recently issued are those contained in the work of Sr. J. Albarracin, a member of the last Argentine exploring expedition in Patagonia, and showing the courses of the Negro, Limay and Collon-Cura and the Lake Nahuel-Huapi, of which the Limay is the outlet. This lake is 583 metres above the sea, and its shape is different from that originally reported.

The Argentine Republic in general may be said to consist of the flat Pampas and of the Cordilleras, but there are also subordinate chains which rise out of the Pampas, and others in front of the main Cordillera. The Pampas incline towards the southeast, and some of the peaks which rise in their midst reach a considerable

height, as, for example, Nevado de Famatina (6,024 metres) and Nevada de Aconquija (5,400 m.): toward the south these Pampas sierras diminish in height.

The province of Santa Fe (Argentine Republic), according to the census of June 8, 1887, now contains 220,332 inhabitants, against 187,000 in 1869. The municipality of Córdoba, a square of 26 kilometres on each side, contained in October of the same year 66,247 souls, while in 1869 it had but 34,458. Buenos Ayres has now a population of 424,873, and Rosaria 50,914.

Geographical News.—Algeria.—The last census (1886) of Algeria gives a population of 3,752,196, being an increase of nearly half a million above the population in 1881. Of this increase 24,209 are Frenchmen, and nearly 22,000 natives of other European countries. There has been an influx of more than 17,000 Moroccans into Algeria, while Mohammedan-French subjects have increased from 2,842,497 to 3,264,481.

According to Mr. N. J. Dixon, the population of the various States of Colombia is as follows: Boyaca, 483,874; Cauca, 435,690; Santander, 423,427; Cundinamarca, 409,602; Antioquia, 365,974; Bolivar, 300,000; Tolima, 230,821; Panama, 220,600; and Magdalena, 85,255; making a total of 2,955,243.

GEOLOGY AND PALÆONTOLOGY.

Notes on the Rockford Shales.—The lithological and palæontological characters of the Rockford shales of Iowa differ considerably at different localities.

For example, the shales which are seen at the south exposure at Owens Grove, Cerro Gordo county, differ conspicuously, in many respects, in their lithological and palæontological characters, from the same beds observed at other localities.[1] The differentiation of the fauna at this place is strongly marked. The three species of Pachyphyllum[2] which occur at Hackberry and Rockford, are here replaced by a new species of this genus.

[1] For a detailed description of the Rockford Shales, and the limestone which immediately underlie them, reference may be made to a paper by the author, on "Contributions to the Knowledge of the Devonian Fauna of Iowa, with a Description of the Rockford Shales," now in press by the Davenport Academy of Science.

[2] In a paper, now in the hands of the printer, the author has described three new species of this genus.

The species *Cystiphyllum davidsonii*,[1] which occur here in considerable numbers, also entirely replace *Acervularia inequalis*, of other portions of these beds. The Stromatoporoid forms, which occur at other localities, are here replaced by a single, undetermined species of this genus. Specimens belonging to the following genera are also found here, but are not known to occur elsewhere in the shales. *Pleurotomaria*, *Saxonema*, *Syringopora*, *Alveolites*, *Gyroceras*, etc.

In connection with these, we have obtained large numbers of new, and described, species of Lamellibranchs, which do not occur (or if so, in small numbers) elsewhere in this formation.

But the chief interest attaches to a certain very large, and undetermined species of Trilobite, which occurs here, and entirely replaces all other species of crustaceans which are known to occur at Hackberry and Rockford. The occurrence of this species in these beds is a matter of considerable interest, from the fact that it is the first instance of the known occurrence of any of these forms in the Rockford shales and indeed, in any of the Devonian rocks of northern Iowa.

The great variation in the lithological and palæontological characters of the shales at this place, from those observed at an exposure one and one-fourth miles to the north, as well as those at Hackberry and Rockford, led us at first to doubt their equivalency. But subsequent collections showed a considerable number of typical Rockford shale species (as shown by the following list), which prove them to be equivalent to other portions of this formation, as observed at other localities. The following enumeration is that, of some of the typical shale forms occurring here.

Spirifera whitneyi, *Spirifera hungerfordi*, *Atrypa hystrix*, var. *planosulcata* Webster, *Strophodonta reversa*, *Strophodonta canace*, *Campophyllum nanum*, *Zaphrentis solida*, *Cystiphyllum mundulum*, and *Naticopsis gigantea*. Although the number of species represented is considerable, yet their occurrence in individual numbers are usually small.

Loxonema gigantea, n. sp.—Shell large, cylindrical, sloping rapidly from the blunt apex. Length of adult individual from ten to thirteen and one-half centimetres. Volutions from six to seven, rather strongly convex at or below the centre, the last one strongly inflated, very oblique. Suture strongly defined; aperture circular or nearly so; shell thick, surface marked by minute curved striæ. This species more closely resembles *L. robusta*, of Hall (15 Regents Report of New York, p. 52) than any other described species known to me. It differs, however, from that species in that the

[1] This variety approaches more nearly the form from Alpena, Mich., than to those from any other portion of the Devonian rocks of Iowa. Only two specimens of this species have ever been obtained (so far as known to me) from any other portion of this formation.

shell is larger, the apex more blunt, the greater obliquity of the volutions, and in their greatest convexity being at or below the centre. Position and locality, Rockford shales, Owens Grove (south exposure), Cerro Gordo county, Iowa.

Loxonema owenensis, n. sp.—Shell very large and robust, subconiform; spire rather rapidly ascending, apex blunt. Volutions eight to ten or more, very oblique, strongly inflated, most prominently so below the centre, rounded. Suture deeply channeled; shell from two mm. to six mm. in thickness; aperture subovate. Surface apparently smooth. The depth of the suture in this species is very much greater than the suture in either the foregoing or following species. Height of adult specimens from fourteen to sixteen and one-half centimetres; diameter of body volution from four to five centimetres. This is, we believe, the largest species of the genus yet described. Position and locality, Rockford shales, Owens Grove (south exposure), Iowa.

Loxonema crassum, n. sp.—Shell large, subconiform depressed, rapidly broadening from the blunt apex. Volutions from five to seven, slightly flattened or broadly rounded; suture strongly channeled below; shell very thick; surface apparently smooth; aperture ovate. This species differs from *L. gigantea* in its more robust, depressed form, and the less convexity and obliquity of its volutions. Position and locality, Rockford Shales, Owens Grove (south exposure), Iowa. Quite a large number of specimens of each of the species described have been secured, and their specific differences are shown to be constant and well marked.—*Clement L. Webster, Charles City, Iowa.*

Some Extinct Scleroderms.—In 1887, in the *Memorie della Societa Italiana delle Scienze* of Naples (3d series, v. 6, No. 4),[1] Baron Achille de Zigno has published descriptions and illustrations of two very interesting Scleroderms from the Eocene beds of Italy. One of these is the *Protobalistum imperiale* of Massalongo, the other a previously unknown species considered to be congeneric with the former and named *Protobalistum Omboni;* both were obtained from the celebrated Mount Bolca beds. The most casual examination will convince one who has had much experience with recent fishes that the two species have little in common and belong to very different genera if not families. Both are, however, important for the light they may throw on the genetic relations and former distribution of the Scleroderms, but each owes its importance to a different reason.

The generic description of *Protobalistum* given by Baron de Zigno is based on the assumption that there are certain characters

[1] Duc nuovi pesci fossile della famiglia dei Balistini scopertinel terreno eoceno del Veronese. (8 pp., 2 pl.)

which are common to the two forms, which does not appear to be justified by the specimens; on the development of 4 to 6 dorsal spines, of spinous rays to each pectoral ("pectorales radiis duobus spinosis"), and of 1 to 3 spines to each ventral ("ventrales radiis 1—3 spinosis, retro-flexis"). Such features as the last two are so incompatible with the structure of living Sclerodерms that the suspicion is unavoidable that their ascription to the extinct forms is due to some error of observation or interpretation. The principal feature described and corroborated by the illustrations is the number of dorsal spines. The arrangement of the spines is nevertheless very different in the two species.

The typical *Protobalistum* (*P. imperiale*) has six (or seven) dorsal spines, rather widely separate from each other, extending from over the eye far back upon the posterior half of the body, and very elongate (the foremost especially); the soft dorsal as well as anal are very short. No pectorals and ventrals are represented in the figure, although it is asserted that there is a ventral spine.[1] The character of the dorsal fin is very different from that exemplified in any of the Balistids or Triacanthids. None of the Balistids have more than three dorsal spines, and all having that number have the second close behind the first, and modified to lock it in erection, in such a manner as to have obtained for the species the name Trigger-fish. The *Protobalistum* should therefore be apparently considered as the type of a peculiar family with generalized characters and allied to the progenitors of the Siganids and Teuthidids; the family name in such case would of course be *Protobalistidæ*.

The so-called new *Protobalistum* (*P. Omboni*) has four dorsal spines moderately approximated and confined to the forward part of the back; the first spine is very strong and the others very short; the soft dorsal is elongated, and the anal is oblong; the caudal peduncle is long. In fact, the species has the physiognomy as well as the structural characteristics (so far as known) of the Triacanthids, and there appears to be no reason for doubt that it belongs to that family, and that it is related to the genera *Triacanthodes* and *Hollardia*, with which it agrees in the convex caudal fin, and perhaps the development of one or two axillar rays, besides the elongated ventral spines. ("Le ventrali sono constituite da tre soli raggi spinosi rivolti all' indietro e addentellati nei loro margini, di cui il primo e lungo 27 millimetri, il secondo 25 el il terzo 20, e cadauno alla base ha il diametro di 2 millimetri.") The caudal fin is very large, and has a convex posterior margin, thus differing from that developed in the Triacanthinæ. No generic

[1] Delle pettorali non si scorge sull 'esemplare alcuna traccia e delle ventrale si vede soltanto un solo raggio spinoso lungo tre centimetri ripiegato all 'indientro lungo il ventre (p. 4).

name being available for the fossil, it may be named *Protacanthodes Omboni*, the name recalling that the foremost elements of the spinous dorsal as well as ventrals are enlarged spines, as well as that it is a forerunner of the Triacanthids. It differs from *Hollardia* and *Triacanthodes* in the oblong caudal peduncle and enlarged caudal fin while its physiognomy rather recalls the true *Triacanthi.* The occurrence of a form so closely related to the *Triacanthodes* of the Japanese sea, and to the *Hollardia* of the Caribbean in the eocene seas of Europe, is worthy of special note, and this is a sufficient reason for the present communication.

The nearest extinct associate of *Protacanthodes* is not *Protobalistum* but *Acanthopleurus* Ag. The two belong to the same family but appear to be otherwise distantly related. The other extinct genera of Sclerodermas, *Balistomorphus* Gill, *Acanthoderma* Ag. 1843, not Cantraine, 1835, and *Bucklandium* Koenig—*Glyptocephalus* Ag.) are rather to be associated with the Balistids.

The exact characters and relations of all these fishes remain to be known.—*Theo. Gill.*

THE PHYLOGENY OF THE HORSES.[1]—This brochure of 71 pages, illustrated by two excellent plates, cannot fail to instruct the student who is unfamiliar with this subject. The authoress shows a great degree of familiarity with the history of the facts known in this connection and they are set forth with considerable fulness of detail. She has been more fortunate than some of her predecessors in avoiding record *in extenso* of the mythology of the subject, which has been long since consigned to its place in the waste-basket by American palæontologists. We allude to the Eohippus, Miohippus, and Pliohippus, which still appear occasionally in theological works and school-books of America and England. A considerable part of the essay is devoted to the endeavor to prove that the genera Palæotherium and Hippotherium must be excluded from the line of descent, which has continued from *Protogonia puercensis* through Phenacodus, Hyracotherium, etc., to Equus. She describes and figures with much care certain bones of the carpus and tarsus of Anchitherium, Hippotherium, and Equus, in evidence of this position as regards Hippotherium. We say with reference to this question, that in discussing the phylogeny of *genera*, one must confine himself to *generic characters*, and it is necessary to ascertain what these are in the skeleton before we can use them properly. There are some species of supposed Hippotherium of North America which approach Equus so closely in dental characters that the descent of some species of the latter from them looks probable. Probably the species of Equus are polyphyletic,[2] some coming from

[1] Etudes sur l'Histoire Palæontologique des Ongulés, II, le Developpement des Equidæ. Par Marie Pavlow. Moscow, 1888.

[2] I have expressed this opinion in an article on the Perissodactyla in American Naturalist, 1887, p. 1075.

Hippidium and some from Hippotherium through the intermediate form with the molar teeth of the latter genus, and the single metapodials of the former. This genus has not been named, and I will now call it *Hippodactylus,* and give as the type *Hippotherium antelopinum* of Falconer from the Sivalik formation of India. It enters the Equidæ.

We find in this essay two new family names, whose introduction we regret. One of these is the "Hyracotheriidæ," which is perhaps a misapprehension of my own Hyracotheriinæ. This group cannot be separated as a family from the Lophiodontidæ so far as I can see. The other family name is Pachynolophidæ. Pachynolophus was based by Pomel on the *P. duvali,* which is an undoubted member of the family Lophiodontidæ, if the figure of Pictet (Traité de Palæontologie) is correct, and I believe it to be so after examination of specimens in Paris. But Lydekker and Pavlow place in this genus the *Hyracotherium siderotilicum* Pictet, an animal which is not only no Pachynolophus, but is not even a member of the Lophiodontidæ. Supposing its digits to be 4–3, it will enter the Menodontidæ, where I have placed it,[1] making it the type of the genus Acoëssus. How many of the species referred to Pachynolophus belong to Acoëssus I do not know, but in any case neither genus is a type of a separate family.

A further acquaintance with the American literature would have saved some minor errors. Thus it is stated that the limbs of Protohippus have not been described. They were described by me in 1873 (Annual Report U. S. Geolog. Survey Terr.), and were figured by Wortman in the *Revue Scientifique,* 1883, p. 712, from my blocks. The ancestral relation of Phenacodus to the Diplarthrous ungulate series, is ascribed to Wortman; but this view was published by the present writer long before that gentleman. The synonym Orotherium is ascribed to Cope instead of to Marsh. Merychippus is not different from Protohippus.—*E. D. Cope.*

Hayden Memorial Geological Fund.—Mrs. Emma W. Hayden has given in trust to the Academy of Natural Sciences of Philadelphia the sum of $2,500, to be known as the Hayden Memorial Geological Fund, in commemoration of her husband, the late Professor Ferdinand V. Hayden, LL.D. According to the terms of the trust, a bronze medal and the balance of the interest arising from the fund are to be awarded annually for the best publication, exploration, discovery or research in the sciences of geology and palæontology, or in such particular branches thereof as may be designated. The award and all matters connected therewith are to be determined by a committee to be selected in an appropriate manner by the Academy. The recognition is not to be confined to American naturalists.

[1] Classification of the Perissodactyla. Proceedings Amer. Philosophical Society, 1881.

Geological News. — Permian, Trias, Etc. — La Marmora, in his famous "Voyage in Sardinia," states that the Permian Triassic and even Liassic rocks seem to be entirely lacking in Sardinia. True Triassic beds, however, have been found in the southwest near Iglesias, while in the north of the island, near Nurra, Permian and Triassic strata occur. Descriptions of these rocks, with lists of their characteristic fossils, may be found in Bulletin XII. (2d series, vol. 11) and Bulletin XV. (2d series, vol. 5) of the *Comitato geologico d'Italia.*

Jurassic. — The result of the researches of M. L. Dollo into the structure of the Iguanodontidæ is to prove that Iguanodon cannot be descended from Hypsilophodon or *vice versa*, but that they are the types of two utterly distinct families.

According to Dr. J. V. Deichmüller, the number of specimens from the lithographic slates now in the Dresden Museum reaches 1680, comprising 114 genera and 193 species, and including 48 species of fishes, 53 of insects, 48 of crustacea, and 21 of cephalopoda. Among the insects nine forms belong to the Orthoptera, seventeen, besides several still unidentified, to the Neuroptera, six to the Hemiptera, and eighteen to the Coleoptera. Of the Neuroptera two specimens only are *Neuroptera vera*, while the Termitina are represented by two, and the Ephemeridæ by one species. The remaining pseudo-neuropterous forms, comprising more than one-third of all the insect specimens, and nearly 95 per cent. of the neuropterous remains, belong to the Odonata. In his "Die Insecten aus dem lithographischen Schiefer im Dresdener Museum" (1886) Dr. Deichmüller not only gives fuller descriptions of previously known forms, but describes two new species of Locustidæ, one of Notonectidæ and one each of Carabidæ, Hydrophilidæ, Scarabæidæ, Buprestidæ, Elateridæ, Pyrrochroidæ, and Chrysomelidæ.

Cænozoic. — M. L. Dollo, in his "Premiére note sur les Chéloniens oligocènes et néogenes de La Belgique," reviews the numerous remains of turtles belonging to the group Athecæ, of which Sphargis is the only existing representative, that has been found in the upper tertiary deposits of Belgium. Remains from the "Rupelian" clay (middle oligocene) were described by P. J. Van Beneden in 1883, under the title of *Sphargis rupeliensis*, while others from the "Bolderien" were by the same palæontologist named *Macrochelys scaldii.* The discovery of additional material has enabled M. Dollo to ascertain that the *Sphargis rupeliensis* of M. Van Beneden differs from the recent form by the presence of a continuous bony ventral armor, formed of a mosaic of small plates, while *S. coriacea* has only longitudinal series of isolated tubercles; by the slighter convexity of the carapace; by the

absence of projecting dentellated ridges upon the carapace; by the margin of the dorsal armor not being rolled downwards; by the greater thickness of the carapace; by the apparent presence of horny plates; and by a skull proportionately shorter, wider, and with thicker bones. The cretaceous genera of the group Athecæ, viz., Protostega and Protosphargis, were without a dorsal armor. M. L. Dollo concludes that all the fossil Athecæ yet found in the tertiary strata must be referred to the genus Psephophorus, and distinguishes four species: *P. polygonus* H. von Meyer; *P. pseudostracion* P. Gervais; *P. scaldii* P. J. Van Beneden; and *P. rupeliensis* P. J. Van Beneden.

From the careful researches of Prof. Scalabrini, supported by those of Dr. Doering and Ameghino, it is now thoroughly established that the sedimentary formations of the Argentine Republic present all the series of Tertiary strata from the eocene to the modern. The Patagonian formation includes three distinct horizons: the lowest eocene, of marine origin, is characterized by *Ostrea ferrarisi;* the middle corresponds to the lower oligocene, is of terrestrial or fresh-water origin and encloses bones of mammals, turtles, crocodiles, and fresh-water fishes; while the upper, of marine origin, characterized by *Ostrea patagonica*, represents the upper oligocene. The earlier conclusions of Darwin and D'Orbigny are thus confirmed, and Burmeister's later affirmations disproved. The remains referred to by Bravard to the Old World genera Anoplotherium and Palæotherium have been demonstrated by Ameghino to belong to two new genera peculiar to the New World, and are by him entitled Scalabrinitherium and Brachytherium, while a third genus near the former takes the name of Oxyodontherium.

M. Larrazet, as the result of his studies upon the character of the skin among fossil rays, divides them into three types: the first approximating to the modern Raja in form and size; the second, which has placoid ossifications with a broad base and small spine, forming the genus Dynatobatis; while the third, the dermal ossifications of which have a long spine and small base, forms the genus Acanthobatis.

Pliocene and Pleistocene. — M. A. Villott thus classifies the alluvial deposits of Dauphinè: (1) Those of the high plateaus, some of which occur at a height of 700 metres above sea level, and which may be referred to tertiary times; (2) The pre-glacial deposits of the lower plateaus, forming the upper part of the high terraces, and entirely belonging to the quaternary epoch; (3) The post-glacial alluvium of the lower terraces, formed after that great extension of the quaternary glaciers. The erosion of the valleys is referred principally to three different periods: (a) that which preceded the quaternary epoch, and was the result of the bursting of the pliocene lakes — a necessary result of the last elevation of the

Alps; (b) that which occurred during the glacial period; (c) that which is the work of the modern epoch.

Four years ago M. G. Rolland announced his belief that the great fresh-water formations of the Sahara are much less recent than had been hitherto believed, the greater portion of them belonging to the pliocene instead of the quaternary age. Subsequent studies of these deposits have confirmed his first opinion, of which he has now found palæontological proof by the discovery of a number of casts of species of Helix belonging to the group of *H. tissoti* and *semperina*, which characterize the lower pliocene of Biskra and Constantine. M. Rolland also shows the synchronism which exists between the different beds of the Eastern Sahara and the corresponding fresh-water beds of the pliocene and quaternary formations in the Atlas region.

MINERALOGY AND PETROGRAPHY.[1]

PETROGRAPHICAL NEWS.—Among the rocks gathered by Reyer[2] during a journey through the Sierra Nevada Mountains, Schuster[3] has found the following principal types: biotite granites, containing microcline and pilitized biotite; saussurite-diorite and quartz-diorite, containing orthoclase; saussurite, pilite, and biotite gabbros; quartz-porphyrites, kersantites, andesites, serpentine, fragmental rocks, and tufas. Although the paper in which these rocks are described consists merely of detailed descriptions of detached rock-specimens, it nevertheless contains many points of considerable interest. Pyrophyllite is mentioned as an alteration product of olivine and of plagioclase; reaction rims around augite and olivine are pictured; intergrowths of biotite and augite, of biotite and hornblende, and the alteration of biotite into pilite and into hornblende, are each described. Chromium mica is mentioned as occurring in a magnesite concretion in serpentine; helminth, as a constituent of a diabase porphyrite, and anorthoclase, as existing in a hornblende porphyrite. A most interesting case of intergrowth is that in which a long, tabular crystal of plagioclase penetrates diallage in such a way that its long edges are parallel to the orthopinacoid of the augite, and its twining lamellæ are parallel to the lines of inclusions in this mineral. Indications of the effects of pressure were seen in a large number of the sections examined.——Dr. Wadsworth[4] has recently published a report embracing preliminary descriptions of the peridotites, gabbros, diabases, and other rocks of

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.
[2] Neues Jahrb. f. Minn., etc. Beil. Bd. v., p. 451.
[3] Ib., Beil. Bd. iv., p. 291.
[4] Geolog. and Nat. Hist. Survey of Minnesota, Bulletin No. 2. Minneapolis, 1887.

Minnesota. The report opens with a restatement of the author's views in regard to the classification of massive rocks[1] and a plea for the more careful discussion of the altered forms of rocks, with reference to the original forms from which they have been derived. The rocks described in this bulletin are typical specimens which have been collected from all over the northern portion of Minnesota by various members of the State Survey during the past few years. They are, therefore, not studied in their field relations to one another. The gabbros and diabases are the most widespread, and are regarded as very closely connected. Among the altered forms of gabbro are placed Irving's orthoclase gabbros[2] and most of his augite syenites, though some of the latter may possibly be altered forms of more acid rocks. Biotite as a secondary product, due to the reaction between magnetite and feldspar, and the same mineral, occurring as an alteration product of pyroxene, are described and figured. Norites, serpentines, hornblende-porphyrites, and many diabases are also briefly described. Lack of time and the impossibility of studying some of the most interesting of the rocks in their field relations prevented Dr. Wadsworth from elaborating many of the points which he has been able merely to indicate in his report.

The rocks comprising the three mountains in the Rhone region —known as Linsberg, Ulmenstein, and Pietzelstein—have been carefully investigated by Möller.[3] This author finds Linsberg to consist principally of a porphyritic rock composed of sanidine, andesine, augite, and nepheline, together with a few other minerals in small quantity. In the rock from near the top of the mountain the plagioclase predominates over sanidine, while in the specimens taken from its sides sanidine is more abundant. The former Möller calls tephrite, the latter phonolite. In the phonolite, corroded grains of hornblende are often surrounded by rims of augite. Associated with these rocks, but in smaller quantity, is a dark nepheline basanite containing corroded augite crystals surrounded by zones of the same mineral, with a similar optical orientation, but a little different composition. The main portion of the rock composing Ulmenstein is a nepheline basanite which, by the subordination of its feldspar, locally passes into limburgite. Some of the larger of the feldspar crystals in this rock show the hour-glass structure frequently seen in augite. The rock of Pietzelstein is a nepheline basalt. Very detailed analyses of specimens of all these rocks are given, and each is very minutely described.——According to Harker,[4] most of the dyke-rocks of the Island Anglesey, off the northwest coast of Wales, are diabases and augite porphyrites. One of these dykes cutting a calcareous shale has converted this rock into a lydianite, in which calcite, clusters of garnet, and anal-

[1] American Naturalist, 1885, p. 497.
[2] Copper-Bearing Rocks. Monog. V., U. S. Geol. Survey.
[3] Neues Jahrb. f. Minn., etc. 1888. I., p. 81.
[4] Geol. Magazine, 1887, Sept., p. 410, and Dec., p. 545.

cite crystals are developed. Other dykes from the northern portion of the island appear to consist of hornblende and biotite picrites. In one case newly formed, almost colorless hornblende is described as forming a cement between crystals of original hornblende, in a manner analogous to the quartz cement in indurated quartzites.

MINERALOGICAL NEWS.—The diamonds found in the Province of Minas Geraes, Brazil, are associated with the oxides of titanium, martite, monazite, and xenotine. They are usually found in quaternary alluvial deposits, but have their origin, according to Gorceix,[1] in the itacolumites and mica schists which are archæan. In these rocks they occur in deposits analogous to those of topaz, anatase, rutite, etc. All these minerals occupy well-defined bands in the itacolumite, and are original in it, and are not derived from some older rock, whose detritus supplied the material for the itacolumite and the mica schist. This explanation of the origin of Brazilian diamonds is quite different from that offered[2] in the case of diamonds of the African and American fields.——*Polianite*, the anhydrous manganese dioxide, has heretofore not been found in sufficiently well-crystallized specimens to admit of a satisfactory determination of its crystallographic constituents. The investigations[3] seemed to point to an orthorhombic symmetry for it. Messrs. Dana and Penfield[4] have recently proven it to be tetragonal and isomorphous with cassiterite, with $a : c = 1 : .66467$. The crystals examined are composite, being composed of several tetragonal individuals which produce a body with an orthorhombic habit. Their specific gravity is 4.992, and their composition as follows:—

MnO	O	Fe_2O_3	SiO_2	H_2O	Insoluble.
80.81	18.16	.16	.36	.28	.16,

revealing a very pure manganese dioxide.——In the basalt from the neighborhood of Périer (Puy de Dôme) are little veins of clayey material[5] in which are imbedded crystals of augite and lozenge-shaped flat plates of *feldspar*. The plates are sections parallel to the clinopinacoid, bounded by the planes oP and $P\bar{\infty}$ equally developed. They are frequently twinned with $\infty P\bar{\infty}$ as the composition face.——Jannetaz[6] has analyzed *uranite* from the Island of Madagascar, with this result:—
——Igelström[7] has discovered a manganese, rich and antimony-

P_2O_5	NO_2	Fe_2O_3	CaO	Loss (water).
14.93	55.08	1.365	6.51	22.08

[1] Comptes Rendus, cv., 1887, p. 1139.
[2] American Naturalist, 1887, p. 664.
[3] American Naturalist, March, 1888, p. 249.
[4] Amer. Jour. Sci., March 1888, p. 243.
[5] Lévy: Bull. d. l. Soc. Franç. d. Miner., X., 1887, p. 69.
[6] Ib., p. 47.
[7] Bull. Soc. Franç. d. Min., ix., 1887, p. 218.

bearing *berzellite*, associated with barite, tephroite, calcite, and hausmannite, in veins and nests in the vicinity of Sjögrufan, Grythyttan parish, Örebro, Sweden. The new mineral, to which the name *pyrrhoarsenite* has been given, has a color resembling that of crocoite. It has a hardness of 4, and is soluble in hydrochloric acid. It possesses the optical properties of berzellite, and a composition as follows:—

$As_2O_5+Sb_2O_5$	MnO	CaO	MgO	SiO_2	H_2O	$Al_2O_3+Fe_2O_3$
58.06	17.96	18.68	3.58	1.02	.85	traces.

which may be represented by the formula $(Ca,Mn.,Mg)_3(As, Sb)_2O_8$.

MISCELLANEOUS.—Cohen[1] has re-investigated the subject of the pleochroic halos (Höfe) in the biotites of granite and gneiss, and is thereby led to the conclusion that they are produced by the accumulation of organic substances in the neighborhood of the inclusions they surround, and are not due to the aggregation of mica molecules richer in iron than those forming the main portion of the mineral in which the halos occur. He finds, contrary to the experience of Lévy,[2] that the halos are not affected by treatment with hydrochloric acid, as they should be if they contain a large proportion of iron, but that they are destroyed by heating to a temperature considerably higher than that which is necessary to obliterate the halos in muscovite and cordierite, in which minerals this phenomena is now generally believed to be due in some way to an organic substance.——Franklinite, together with its natural associate, zincite, has been artificially produced by Gorgeu[3] by subjecting to a cherry-red heat an intimate mixture of one part of sodium sulphate, one-half part of zinc sulphate, a quarter to a half part of ferric sulphate, and a little manganese sulphate.[4]

BOTANY.[5]

THE COLLECTION AND STUDY OF CHARACEÆ.—Characeæ are neglected by botanists in general, who seem to have an aversion to all aquatic plants, mainly, it is presumed, from the fact that the collection of aquatics is a specialty. One must go prepared with dredge and rake, with paper and muslin, in order to gather successfully plants of this sort. It has come about that very few bits of Characeæ have been gathered here and there by expeditions and by

[1] Neues Jahrb. f. Min., etc. 1888. I., p. 165.
[2] Comptes Rendus, xciv., 1882, p. 1196.
[3] Bull. Soc. Franç. d. Min., x., 1887, p. 50.
[4] Cf. American Naturalist, 1887, p. 475.
[5] Edited by Prof. Chas. E. Bessey, Lincoln, Neb.

individuals in America up to recent years; but it is evident that these plants abound in our waters, and that our Chara-flora is varied and strongly characterized. Probably not one-half of the American species have as yet been brought to light, but it is confidently anticipated that a better knowledge of their structure and classification will result in a more widespread interest in them.

These plants, often delicate or brittle from an incrustation of lime, are easily destroyed by waves, so that they are rarely found on exposed shores, unless in water deep enough to be beyond the reach of the surface movements. They flourish best in sheltered bays and smaller ponds, especially if a tolerably uniform level of water be maintained. Great changes of level are destructive, alike to species that love the sun and grow in shallow water, and those that hide away in the depths. It is rare, therefore, that Chara-hunting is profitable in ponds or lakes which feed canals or factories. One prefers the land-locked sheets of water fed by springs, especially if there be a sandy bottom. Temperature has but little influence upon them, though the South has its distinctive species, as well as the North. One species, at least, *Chara fragilis*, is universal, found in every country and clime, in ice water at the North, and in the hot springs of the Yellowstone, "hot enough to cook an egg in four minutes."

The best condition of the plant for examination is when it has mature fruit. The time at which this occurs is usually late summer or early fall, though a few species mature early in the spring, and die off in summer. At the South the species are often in good condition the year round, the old fruit holding on, even after new shoots have started from the old nodes.

To gather Characeæ successfully a dredge must be used; for shallow water a small fine-toothed rake is preferred, but for deeper water (one rarely finds them at a greater depth than ten feet) the dredge and line are essential. The best dredge for all purposes is the one recommended by Professor Nordstedt, made as follows: — A disk of lead about three inches in diameter and three-fourths of an inch thick has imbedded in its circumference a row of hooks, about ten in number; through the centre of this disk is passed an iron rod, which projects about three inches below the disk and about nine inches above; to the ring in the upper end toward which the points of the hooks are directed a cord is attached. The dredge weighs about two and a half pounds, and catches all sorts of "weeds" growing on the bottom.

The dissection of these plants is perfectly simple. The delicate species are placed in water until their normal form is restored (if they have been dried), and a portion is put in a "cell" on a glass slide and examined under a two-inch objective; sometimes, but rarely, a higher power is needed for determining fine points, such as the structure of the cortex.

Should the species be incrusted with lime, a piece should be

placed in a little strong vinegar till the lime is completely dissolved, then washed in pure water and examined.

Specimens foul with mud must be cleaned in water with a camel's hair brush, but this is liable to detach the globules of fruit, and is only occasionally to be resorted to. Should it be desirable to preserve bits for future reference, they are best mounted in glycerine-jelly, in "cells" deep enough to avoid crushing and shallow enough to permit free examination (flattened brass curtain-rings make excellent cells). When the jelly has dried at the edges, turn on a ring of white zinc cement. — *T. F. Allen, in "The Characeæ of America."*

THE FIBRE OF THE BANANA. — In a report by the United States Consul, L. J. Du Pré, at San Salvador, Central America, the following statement possessing botanical as well as commercial interest occurs: —

"Inquiries made by manufacturers of coffee sacks, and by rope, cordage and paper makers addressed to the consulate are answered by the statement that each banana tree is two and a half to three feet in circumference at its base. Its tapering fibrous body, without a branch, is from ten to fifteen feet in height. These fibres, separated by a thin pith, are of the length of the body of the tree, in which there are no joints. These fibres are used here just as they are taken from the tree and dried, as shoe-strings and as cords for all purposes. The several threads constituting them are of silken fineness, and infinitely separable. The natives use them in making 'bridle-reins' and lariats for most recalcitrant mules. The raw material costs only transportation to the rope-walk Each banana tree bears in the twelve months of its existence only one bunch of fruit, but from two to four or ten trees spring from the roots of the one that has fallen. The bunch of bananas is worth here fifteen cents, and the dead tree nothing. A cordage factory, or paper mill, or coffee-sack maker, were not the defunct banana trees numberless, would give for each dead tree ten times the value of the fruit it produced. Split, dried and packed, the bodies of the banana trees might be shipped profitably to the United States. * * *

"The stem of each banana leaf consists of the toughest and finest threads, and these leaves two and a half to three feet wide, and ten to fifteen feet long, resting on the heads of the native women, are umbrellas in the rainy season in the roofless market places and streets of Salvador. They are the carpets on which they sit, and the beds on which they repose."

GRAY'S CONTRIBUTIONS TO AMERICAN BOTANY. — It is with melancholy interest that we note this last incomplete contribution, the final one of a long series, which appeared in the Proceedings of the American Academy of Arts and Sciences. This was presented

by Dr. Sereno Watson, on March 14, 1888, more than a month after the lamented author's death, and is entitled "Notes upon some Polypetalous Genera and Orders." Certain doubtful Rutaceæ are discussed, among them *Xanthoxylum*, to which correct orthography the author calls particular attention.

The notes on Vitaceæ, by way of review of Planchon's "Ampelideæ," he had scarcely commenced "when his work upon the Flora of North America ceased." He pointed out, however, that if we accept Planchon's numerous genera (see AM. NAT. for March), we must take up Rafinesque's name, *Quinaria*, instead of *Parthenocissus* for the Virginia Creeper and its relations. Dr. Gray, however, pronounced emphatically against the innovation, maintaining that "the *Ampelopsis quinquefolia* Michx., remains as the proper representative of the genus, and should preserve the name." Further he says: "It may still be questioned whether the mass of Ampelideæ can be definitely separated from Vitis, and into how many genera divided; but surely *Ampelopsis*, with the Virginia Creeper as the type, must be admitted as a good genus."

A NEW TYPE OF LICHENS. — Formerly it was supposed that all lichens were ascomycetous, and it was quite a shock when a few years ago the announcement was made of the discovery of certain hymenomycetous lichens. We are now told by Massee (Arch. Sci. Phys. and Nat., xviii.,) of a couple of genera of gastromycetous lichens. Thus we have now known the following groups of lichens: (1) Ascolichenes, (2) Hymenolichenes, and (3) Gastrolichenes.

THE ASH OF TILLANDSIA USNEOIDES.—This plant, popularly known as the Florida long-moss, is considered as a typical epiphyte. Reliable observers have stated that it will grow and increase, month by month, on a support as juiceless as a telegraph wire. Its roots are looked upon as mere hold-fasts—anchors, to prevent the plant from falling to the earth. No absorption is supposed to take place through those roots; thus the plant is considered to differ from parasitic species like Phoradendron, etc. Yet it is well known that this so-called epiphyte has a certain proportion of mineral matter in its make-up. At the suggestion of Professor Henry Trimble, I have made an analysis of this ash, and have found the composition of it to be full of interest. If the roots do not absorb the juices of the supporting trees, then this mineral matter found in the plant must be collected from the air. It is hardly to be supposed that the floating dust of the forests where the *Tillandsia* grows is very abundant; and it seems almost absurd to think that all the elements found in the ash can have been collected in this way. The following are the results obtained from about 100 grammes of the dried plant. The moss was in a green condition when received. *Total ash*, 2.95 per cent. Composition:—

Silica	10.300 per cent.
Ferric oxide	2.100 per cent.
Alumina	2.600 per cent.
Oxide of manganese	1.672 per cent.
Lime	12.700 per cent.
Magnesia	11.351 per cent.
Potassa	13.759 per cent.
Soda	14.856 per cent.
Sulphuric acid	7.419 per cent.
Chlorine	6.947 per cent.
Carbonic acid	12.900 per cent.
Phosphoric acid	3.034 per cent.
	99.638

But one other analysis of this ash has been found by me; that of Avequin,[1] in 1835, which is recorded in the following way (in effect, as I have not the exact language at hand):—

1,000 grammes of dry plant gave 32.35 grammes of ash, composed of—

Salts of potash (phosphate, sulphate, carbonate and chloride)	11.47 gr.
Lime (partly as carbonate)	5.96 gr.
Phosphates of lime and magnesia	9.26 gr.
Silica containing a little iron and manganese	5.66 gr.
	32.35

It will be observed that the total ash (3.235 per cent.) is nearly the same as that obtained by me. If the iron and *alumina*, as well as the manganese, in my analysis, are added to the silica, the sum is 16.672 per cent., which is not greatly different from the impure silica of Avequin, 17.186 per cent. It would therefore appear that the plant must uniformly have some such ash as that found above. (Indeed, the ash of any one plant, as is well known does not vary greatly.) What, then, shall we think? That the roots do absorb the characteristic ash-constituents from the trees on which they grow? That would seem to me more rational than to suppose them to be absorbed from the floating matter of the air. But if we do arrive at this conclusion, our idea of the term epiphyte must certainly undergo a radical change.—*T. Chalkley Palmer.*

THE EFFECT ON VEGETATION OF THE VARIABLE RAINFALL OF NORTHWESTERN MEXICO.[2]—First, want of water. Those who have travelled over the northwestern portion of Mexico will, I think, agree with the writer that it is a dry, barren section, and in want of water. Rains are very uncertain, often years passing without a shower sufficient to cause a good growth of vegetation. When the first white settlers made their homes in this region, over two hundred years ago, they did so during a very dry period of several months, during which they formed the conclusion that the

[1] Journal de Pharm. et Chimie [3], xxxv., 95.

[2] Read before the Botanical section of the Biological Society of Washington, March 7, 1888.

region was one in which it never rained. Their effort, therefore, was to do without rain. The settlements were made near springs or streams, both of which were few, and consequently the settlements limited. During the thirty-two months previous to last August enough rain had not fallen to produce vegetation of sufficient length to be cut for hay. The appearance of the country during the dry season is that of a waste, destitute of food for man or beast, except in favored spots along the creeks and springs; and if nature did not endow some of the plants with power to bloom and mature their fruits during different periods of the year, this desert country would be still more uninviting. The various numbers of the Cactus family produce their showy and attractive flowers during the dry season, these being followed by the sweet, juicy and nutritious fruit, during the hottest part of the year, about the last of June.

There are some forms of the Leguminosræ which also bloom and mature fruit during the dry period when there are no leaves upon them. These plants which bloom and fruit during the dry season, though but a small portion of the whole, contrast very agreeably with the pinched, withered, and resting plants that surround them.

What adds still more to the desert appearance of the country at this season of the year is the character of the soil; the hills and mountains, which are very rocky, have now put on their sombrest, reddish brown, and not a vestige of green is observed upon their surface.

A stranger coming into the country during the dry season would ask the question, "When or how often does it rain?" A botanist desiring to make a collection can only gather the plants that bloom during the dry season, and must wait for the rain in order to complete his collection. One serious effect of the insufficient rains is seen when the shrubs and annuals start into growth after a shower, only to be killed or fail of maturity during the subsequent drought.

The second cause of the scanty vegetation of this region is excess of water. The violent rains and water-spouts which occasionally occur are exceedingly destructive.

In 1717 there was a great rainfall, and those people who had come to the belief that it never rained there, and had only provided themselves with the cheapest and easiest contrivances in which to live, found that it did rain — for forty-six hours it rained so excessively that it destroyed nearly all the food the inhabitants had. The churches and other buildings of the missionaries were leveled to the ground, they being of unburnt brick, while the fields that had been planted, or prepared for planting, were denuded of every plant — natural or cultivated. The rains left in place of the soil so thick a coating of sand and stones that the fields had for the most part to be abandoned and new ones prepared.

Not far from Guaymas is a small village, celebrated for its gardens. A few years ago this place was devastated by heavy rains; many houses were carried away, some gardens greatly injured and others entirely obliterated. Where once there were gardens is now a large area covered with rocks, gravel and sand, resembling a dry river bed. The inhabitants point out to you many localities once fertile, now barren in consequence of excessive rains. Last summer a waterspout fell in the village of Molage in Lower California. The village is built on the brow of a range of low rocky hills, in front of which runs a small stream used to water the gardens upon either side. So sudden and great was the fall of water that before the inhabitants were aware of it the flood was upon them and many houses swept away, the people having barely time to escape with their lives. After the waters had subsided, the valley which had been filled with gardens and green fields presented a rocky waste, as barren as the adjoining hills upon which no rain had this year fallen. While travelling in this part of Mexico last autumn my attention was frequently called to spots injured by the fall of waterspouts. In a country with so little land suitable for cultivation, the loss of however little is severely felt by the inhabitants.

The period which is considered the rainy season lasts from July to December. In one place the rains may commence in one month, in another place some other month, and no two places, however near, are likely to have the same amount. For example, about Guaymas last season the rainy season commenced in the middle of August and ended about the first of October, during which four good rains fell, while at Angel's Bay in Lower California, the first rains were a shower in the early part of November and another about the first of December. After this vegetation quickly sprang up and into bloom, so that at the time of my visit the place looked like spring, while at the same period the vegetation about Guaymas, only two hundred miles distant, had come to maturity.—*Dr. Edward Palmer.*

ZOOLOGY.

Kidney in Sea-Urchins.—The brothers Sarasin (*Zool. Anzeiger*, 227) claim that the brown structure which surrounds the stone canal of the sea urchins, and to which numberless functions have been ascribed, is in reality a nephridial apparatus. In Asthenosoma this organ rests below on the circumoral blood and water rings, and throughout its extent it forms a large hollow tube. From this cavity are given off numerous large glandular folds, composed of cells which resemble those of renal organs, and notably those of the

Molluscs. These glandular pouches empty into the main lumen by narrow ducts, while delicate canals, following a contorted course, extend to the periphery of the organ and terminate by ciliated funnels in the body cavity in a manner which recalls the nephrostomes of segmented animals. The excretory duct runs towards the aboral surface, and beneath the stone canal forms a narrow duct, both stone canal and ureter uniting in a common collecting vescicle which empties through the madreporic canals.

Life History of Hair-Worms.—In a recent paper on the hair worms L. Camerano discusses several points in connection with these forms. He thinks that the same species may occur in different hosts, the filiform condition being found only in insects. Man may be occasionally a host for some of the larval stages. The cycle of the individual is as follows: The eggs, which are laid freely in the water, hatch out larvæ which swim freely and then obtain entrance to a host when they become encysted and undergo a metamorphosis. The metamorphosis results in the young, filiform larvæ which grows directly into the adult, with sexual organs developed. This lives freely in the water where copulation takes place and the eggs are laid. Some strictures upon the account given by Camerano may be found in the *Zoologisches Anzeiger* for 1888, p. 70. Villot there states that some of Camerano's species are in reality immature forms.

The Origin of Segmental Organs.—M. F. E. Beddard (*Q. J. M. S.*, 1888) discusses the structure of the nephridia in Acanthodrilus and Perichæta. In each of these genera there are several segmental organs to each segment, there being in Acanthodrilus over a hundred apertures in a segment. The glandular part of the system varies much from the typical condition of nephridia in other respects. In Acanthodrilus the inner openings of the tuft-like nephridia were not found, while the excretory ducts of the eight or more organs in each segment were branched, each branch communicating with a nephridiopore. In Perichæta the case is even more complicated. The tubules were not observed to branch in the body wall, but in the body cavity the nephridial system forms a continuous network passing through the dissepiments from one segment to another, while the systems of the right and left side of the body also communicate with each other. Internal funnels were not found. Beddard reviews the opinions advanced by various naturalists as to the phylogemy of the nephridial system of the annelids and thinks that the new facts which he adduces favor the view that the annelid excretory system is directly traceable to that of the Plathelminthes. He, however, differs from Lang in his theory in that he does not regard the longitudinal duct of many annelids as in any way homologous with that of the Plathelminthes, but, in the light of Wilson's researches, as an entirely different structure.

Branchial Eyes of Branchiomma.—Branchiomma is a genus of Sabillid worms remarkable for possessing eyes on the tips of its gills. C. Brunotte (*Comptes Rendus,* 1888, p. 301) has recently described the structure of these, arriving at the following conclusions. They are to be regarded as a new type of compound eye formed of two layers, an outer dioptric and an inner sensory. The outer surface is facetted and beneath each facet is found a small spherical lens situated above a rounded cavity which is filled with a large nucleated cell, and behind this is an elongated refractive body connected with terminations of the optic nerve. This part of the eye is without pigment.

Phosphorescent Organs of Thysanopoda.—R. Vallentin and J. T. Cunningham discuss the structure and functions of the phosphorescent organs of *Thysanopoda* (*Nyctiphanes*) *norvegica* in the February number of the *Quart. Jour. Micros. Science.* These crustacea have long been known to have eye-like organs upon the sides of the body and in the median line,—organs which were universally regarded as accessory eyes until the present decade. There are ten of these organs, their distribution being pretty uniform in all the genera of the family Euphausidæ to which Thysanopoda belongs. All of these organs except those on the peduncles of the eyes have the same structure. Behind the organ is bounded by a layer of wavy laminæ forming a hemispherical unperforated cup open in front. This is compared to the reflector described by von Lendenfeld in Fishes (*vide Amer. Nat.* xxii.). This reflector is lined internally with red mesodermic pigment-cells, and their interior are lined by a layer of large columnar cells, inside of which is a curious fibrillar structure which surrounds the inner half of the biconvex lens. Outside the lens occur a circular cornea followed by the ordinary epidermis and the usual cuticle. All of the cellular layers outside of the pigment zone are ectodermal. The organ in the ocular peduncle differs in the absence of lens and cornea. Some notes occur on the development of these organs.

The observations on the function of these organs are more interesting. In life the animals are incessantly active and in the dark give out, occasionally, short flashes of light. When touched with the hand a flash immediately followed, while handling caused all the organs to shine for five or ten seconds. Continuation of the handling caused an almost unlimited succession of flashes until the animal was exhausted. The stronger the pinch, the longer and more brilliant was the light. If crushed and rubbed between the fingers certain particles were luminous and remained so until dry. Chemical stimulation with corrosive sublimate and nitric acid also produced activity of the organs. Careful microscopical study showed that in the light the inner surface of the reflector possessed fluorescent qualities, while when crushed in the dark this same layer emitted an intrinsic light. A comparative review of phosphorescent organs in other animals concludes the paper.

Reproduction of Lost Parts in the Lobster.—Mr. George Brook (*Proc. Roy. Phys. Socy. Edinb.*, ix.) after a historical résumé of the results of others, details the results of his own observations on the reproduction of lost legs and antennæ in three lobsters which he kept in confinement. He concludes that in the lobster at least—contrary to Reaumur—the new appendage, which is formed beneath a thin pellicle soon after the loss, is only set free at the time of molting. The antennal rudiment is at first conical, then becomes coiled in a spiral, and at the first molt this is set free, but the normal size is not reached until three or four molts. The large claws also required a similar period, becoming as large as their fellow. In one instance the right claw was lost when the pincer of the left side was three inches long. At the next molt the new right pincer was 2⅜ inches long, while its fellow had increased to 3⅜ inches; at the second molt the difference between them was reduced to ½ inch, while the third molt reduced the disparity to ¼ inch. The ambulatory limbs, on the contrary, regain their full size in a single molt, an observation at variance with Chantran's account of the reproduction of lost parts in Astacus.

The Ossicula Auditus of the Batrachia.—The following is an abstract of a paper read before the United States National Academy of Sciences at its meeting in Washington on April 18th, 1888. The conclusions reached are the following:

First.—The relations of the stapes to the quadrate cartilage or bone in tailed batrachians are of two types; in the one the stapes is connected with the quadrate; in the other it is not. The former arrangement is possessed by the Proteida, Trematodera, Amphiumoidea and Pseudophidia (*Cœciliidæ*); the other by the Pseudosauria (*Myctodera*) and Trachystomata. The larval structure in the Pseudosauria, and inferentially in the Trachystomata, is identical with the structure characterizing the adults of the other division. This is confirmatory of the opinion which I have expressed[1] as to the origin of the genus Siren. This is to the effect that Siren is an animal which is descended from a land salamander, and its immediate ancestor became aquatic again at a comparatively late period of geological time. My opinion was at first suggested by the condition of the branchiæ in very young animals, where they are functionally abortive, and do not become respiratory organs until later in life, the largest animals having the best developed gills. The characters of the stapes confirm this view, since they are those of land salamanders, as distinguished from those of aquatic habitat.

Secondly.—There are three types of relation between the ceratohyal arch and the skull. In the one there is no connection between the two, as in the Pseudophidia. Secondly the connection is ligamentous. This is seen in Proteida, Trachystomata, and all Pseudosauria except the Amblystomidæ and Plethodontidæ. The last two

[1] American Naturalist, 1885, p. 1226.

families embrace the third type, in which the ceratohyal is articulated by suture with the quadrate. This last type is the most specialized, since the larvæ of those families display the connection between the ceratohyal and the skull similar to that seen in the type second. Thus the Salamandridæ, which are superior to the Plethodontidæ in their osseus carpus and tarsus and opisthocœlous vertebræ, have the hyoid connected with the skull as in the larvæ of the latter.

Third.—At a stage in the history of the development of the Salientia, the relations of the stapes and of the ceratohyal to the skull are the same as in a transitional stage of the Urodele family of Plethodontidæ. Or taken separately, the relations of the stapes are those of Proteida, Trematodera, and larval Pseudosauria, while the relation of the ceratohyal is as in adult Plethodontidæ and Amblystomidæ. This is when the interstapedial cartilage connects the stapes with the posterior face of the quadrate cartilage, and when the ceratohyal articulates with the posterior face of the quadrate at its distal part.

Fourth.—It is not probable that the epistapedial forms an integral part of a primitive element representing the ossicula auditus, as it originates independently of the interstapedial and mesostapedial.

Fifth.—The interstapedial and mesostapedial do not at any time in the history of the development of the genus Rana form any part of the ceratohyal or Meckelian ventral arches. As the incus and malleus of the mammalian ossicula auditus are segmented from the proximal parts of these arches, embryology indicates that they are not homologous with the ossicula of the Salientia. From this point of view the latter form a special line of development, distinct from that displayed by the Mammalia, unless the developmental record has been greatly falsified by cænogeny. From the embryological standpoint it follows that the ossicula auditus of the Batrachia Salientia must be excluded from the discussion of the homologies of the mammalian ossicula.

Sixth.—But the characters of the Ganocephala and Rhachitomi permit the following reflections, since the latter order is the one from which the Salientia derived their descent. The existence of a well-developed columella auris which is unsegmented, in the former orders, apparently like that of the Lacertilia, suggest that the segmentation seen in the Salientia is a specialization of later origin. This columella has also the position of the proximal part of the ceratohyal in the adult frog and the larval salamander. As the position of this element in all but the youngest tadpoles is a result of cænogeny, it may be inferred that the ossicula auditus of both the Rhachitomi and the Salientia represent the separated proximal end of that arch, and hence be truly homologous with the incus of the mammal. The probability that this is the case is increased by the character of this element in the Pelycosaurian genus Clepsydrops[1] where the columella extends to the cranial wall, leaving

[1] See Proceed. Amer. Philosoph. Society, 1884, p. 41, Pl.

the stapes to one side. This is exactly comparable to the relation between the interstapedial and the stapes seen in the Salientia, except that the two elements are not actually connected as in Clepsydrops. Palæontology then modifies the evidence from embryology, and renders it highly probable that the columella auris, interstapedial and incus are homologous elements, and originated by segmentation from the proximal end of a ventral cranial arch, probably the ceratohyal.

Seventh.—It follows, from what has preceded, that the condition of the representatives of the *ossicula auditus* in the Urodela is one of degeneration.

Eighth.—It becomes probable, but not certain, from the position of the tympanic disc in the Rhachitomi at the proximal base of the quadrate bone, that the epistapedial cartilage has originated as a segmentation from the proximal extremity of the quadrate cartilage, and is therefore truly homologous with the mammalian malleus. This is, however, nothing more than a possibility.—*E. D. Cope.*

EXPLANATION OF PLATE.—AURICULAR AND SUSPENSORIAL ELEMENTS OF BATRACHIA.

Fig. 1. *Trimerorhachis insignis* Cope, from below; $\frac{3}{4}$ natural size.

Fig. 2. *Zatrachys serratus* Cope, corresponding part of the skull to Fig. 1; opposite side from above; $\frac{3}{4}$ natural size.

Fig. 3. *Cryptobranchus allegheniensis* Daud.; × 2; middle part of squamosal bone removed.

Fig. 4. *Diemyctylus viridescens* Raf.; × 8; squamosal bone removed and represented at 2 a; 2 b, end of ceratohyal, showing connection with hyoquadrate ligament.

Fig. 5. *Typhlonectes compressicauda* D. and B.; from the Belize; × 3.

Fig. 9. *Amblystoma tigrinum* Green, larva; × 4; squamosal bone removed and represented (under side) at *Sq.*

Fig. 12. *Rana virescens* Kalm, larva; × 4.

Fig. 13. *Rana catesbeiana* Shaw; larva more advanced than Fig. 12; × 3.

Fig. 14. *Plethodon glutinosus* Green; × 6; squamosal bone removed and represented at *Sq.*

Fig. 15. *Siren lacertina* L.; × $\frac{1}{2}$.

Fig. 16. *Rana pretiosa* Bd. Gird.; × 2; auricular bones removed at *a*, the distal elements in section.

Explanation of Lettering.

A. T., Annulus tympanicus; B. O., basioccipital; C. Br., Ceratobranchial; C. H., Ceratohyal; C. Tr., Cornu trabeculi; E. S., Epistapedial; Eth., Ethmoid; Ex. O., Exoccipital; F. P., Frontoparietal; Hm., Hyomandibular; H. Q., Hyoquadrate ligament; I.

PLATE VI.

Mn
1
Pg
St
OC
E.O
BO
Par
Pg
2
Int
Ty
Sq
E.O
St
QC
3
NQ
CH
2b
CH
Sq
2a
Pob
St
Pg
2
5
Sq
Q
P
T
ExO
St
QC
Pg
Q
CH
9
Sq
ExO
T
Pg
St
Sq
Q
CH
14
Sq
E.O
St
CH
QC
HQ
15
ExO
Sq
S
IS
Pg
Q
J
M
a
MS
ES
AT
16
TP
Eth
Hm
CTr
Se
CBr
CH
Mk
Li
St
12
TP
N
SMb
St
ISt
Sq
Pg
Mk
MxPm
AT
Q
Mn
CH
13

St., Interstapedial; J., Jugal; Ll., Lower labial cartilage; Mk., Meckel's cartilage; Mx., Maxillary; Mn., Mandible; M. S., Mesostapedial; O. C., Occipital condyle; P., Parietal; Par., Parasphenoid; Pg., Pterygoid; Pm., Premaxillary; Q., Quadrate; Q. C., Quadrate cartilage; S. St., Stapes; Sq., Squamosal; Sl. Superior labial cartilage; T., Trabeculum. Cartilage, dotted; ligament and membrane, lined; bone, blank.

Systematic Position of the Monitors.—F. E. Beddard (*Anat. Anzeiger*, 1888) points out that the Monitoridæ are in several features widely separated from the other Lacertilia, and that the same peculiarities tend to ally them to the Crocodiles. Among the points discovered by other naturalists he mentions the arrangement and development of the teeth, the complicated network formed by the hepatic and cystic ducts, and the arrangement of the blood vessels of the neck. The new features are: On cutting through the abdominal wall the viscera are not at once brought into view, as they are enveloped by a fold of the peritoneum which forms a closed sac completely separating the abdominal viscera from the heart and lungs. This feature is compared to a similar structure described by all students of crocodilian anatomy. Huxley compares this last with the oblique septum of the bird, but Beddard thinks it equivalent to the septum and to the so-called omentum as well and at the same time but an exaggeration of the structure occurring in the Monitors. If his points are well made (that the Monitors are not closely allied to the other Lacertilia but rather to the Crocodilia) Beddard thinks that the ancestry of the Crocodiles must be sought in the direction of the Monitoridæ.

A Cow With One Kidney.—I lately saw butchered a healthy cow which had but one kidney, the right one. It was double the usual size and weight; length 11 inches, width 43 inches, weight 2¼lbs., thickness 2 inches. The ureter was present on the left side. —*Henry Shimer, M.D., Mount Carroll, Ill.*

ENTOMOLOGY.[1]

A Laboratory of Experimental Entomology.—Reference has already been made in these Notes (*Ante*, p. 261) to a probable increase in entomological investigations, due to the establishment by the United States Government of an agricultural experiment station in each of the States, in connection with the agricultural colleges. The New York Station has been organized at Cornell University. Provision has been made here for experiments in general agriculture, chemistry, veterinary science, botany, entomology, and horticulture. The Station Council has been very liberal in its provisions for experiments in entomology. A separate building for this purpose is being erected, and provision has been made for thoroughly equipping it.

As this building is novel, both as regards its structure and the purpose for which it is intended, a brief account of it may be of interest. It consists of two parts—a laboratory building and a vivary. The former is a two-story cottage, containing a laboratory for the experimenter and his artist, a shop and laboratory for an assistant, a room for photographic work, quarters for a janitor, store-room and basement. The vivary is in the form of an ordinary botanical conservatory, sixty feet in length. This is divided by a transverse partition into two rooms of equal size. One of these is to be used as a hot-house; the other is to be kept as nearly as possible at the temperature of the outside air. The purpose of this vivary is to enable the experimenter to keep the insects that he is studying alive upon growing plants and to conduct experiments with insecticides, where all of the conditions can be controlled. Especial apparatus for carrying on this work has been devised and is being constructed.

One of these devices is an arrangement by means of which insects living upon roots of plants can be observed continuously without disturbing them. Another is intended to aid in the study of the relations that exist between ants and plant-lice. Others are for experiments in the use of insecticides. Descriptions of some of these devices will be published later.—*J. H. Comstock.*

Aquatic Lepidopterous Larvæ.—A number of instances are on record of Lepidopterous larvæ that normally descend beneath the surface of water in order to feed upon submerged plants. The best-known of these in this country is the species of *Argama* that infest the leaf-stalks of pond-lilies. The habits of this insect were described by the writer several years ago.[2] Although these insects

[1] This department is edited by Prof. J. H. Comstock, Cornell University, Ithaca, N. Y., to whom communications, books for notice, etc., should be sent.

[2] Papilio. Vol. I., p. 147.

spend a large part of the time in water, they are obliged to come to the surface at intervals for a supply of fresh air. There are, however, a few Lepidopterous larvæ that are truly aquatic. One was described by Baron de Geer more than one hundred years ago.[1] This is the European *Paraponyx stratiotalis*. Another was described in 1884 by Wilh. Müller-Blumenau.[2] This is a Brazilian insect, *Cataclysta pyropalis*, which, like the preceding, belongs to the family Pyralidæ.

We have just received an account of a third species, which is described by J. Wood-Mason in a small pamphlet, entitled *Report on the Paraponyx oryzalis, an Insect-pest of the Rice-Plant in Burma*. This pamphlet was published in Calcutta in 1885. The insect described in it is supposed to be a congener of the European species referred to above, although only the larva and pupa have been described. The caterpillar is about seven millimetres in length and is abundantly supplied with tracheal gills. These are in the form of filaments, arranged in little bundles or tufts. There are four longitudinal rows of these tufts, extending nearly from one end of the body to the other; that is, two rows on each side of the body—one above the spiracles, the other below them.

The Orthoptera of New England.—Professor Fernald has just published a manual of the Orthoptera of New England,[3] in which all the species found in that section are carefully described. Analytical keys are given for the determination of families, subfamilies, and genera, and, wherever necessary, there are tables of species. The work is an important addition to the series of handbooks prepared by this author. It will do much towards popularizing a knowledge of this very important order of insects.

Proceedings of the Entomological Society of Washington.—Among the recently published works on our table is No. 2, of Vol. I., of the above-named publication. This number includes the proceedings of this Society during the years 1886 and 1887. It contains a large number of biological and morphological notes, some of them of great interest. The most important of these is the annual address of the President, Mr. L. O. Howard, entitled *A Brief Consideration of Certain Points in the Morphology of the Family Chalcididæ*. The address is much more important than would be indicated by its title, being, in fact, a careful discussion of the external anatomy of these insects.

[1] Memoires pour servir à l'Hist. des Insectes, 1752, Vol. I., pp. 517–541. pl. xxxvii.

[2] Arch. f. Naturgeschichte, Band I., pp. 194–211, pl. xiv.

[3] From the Twenty-fifth Annual Report of the Mass. Agri. College, 1888.

EMBRYOLOGY.[1]

EMBRYOLOGY OF INSECTS AND ARACHNIDS.[2]—Under this title, the friends of the author have issued the results of studies made by the late Dr. Adam Todd Bruce upon the embryology of Thyridopteryx, Chrysopa, Meloe, Mantis, the Grasshopper, Musca, and an undetermined spider. The most complete observations were made upon the development of Thyridopteryx, where Dr. Bruce failed to find the centrolicithal segmentation described as characteristic of arthropod embryology, but rather a central segmentation, the blastoderm arising by a migration of the resulting cells to the surface of the yolk. In his interpretation of the origin of the endoderm the author agrees well with the Hertwigs, regarding the primitive groove as a blastopore, and the cells which rise from its bottom as a compound of mesoderm and entoderm. The neurulation is normal; but the author differs from Hatschek in regarding the inter-neural ectoderm as forming the migratory mesoderm rather than the transverse commissures of the nervous system. The supra-œsophageal ganglion consists of two portions,the anterior supplying the antennæ, the posterior the labrum, thus showing that the antennæ are clearly prestomial in position. The few observations made upon the ontogeny of the compound eyes throw but little light upon their origin.

In the Orthopterous forms the segmentation is much like that of spiders or Astacus, the result being the formation of yolk-pyramids, the yolk proper being free from nuclei at one period. Later, yolk-nuclei were seen, which are regarded as migrating from the blastoderm. The mesoderm arises from the median groove, not from the lateral thickenings. The maxillæ in the embryo are triramose.

In the fly, observations were recorded on the development of the egg and its maturation, Dr. Bruce regarding the yolk as arising from the breaking down of the epithelium of the outer end of the ovarian tube.

In the spider, Dr. Bruce found the invagination for the optic vescicles (*vide* Pl. vi., Figs. lxxx and lxxxi.); but he erred in calling it the amniotic fold, otherwise (as he published a preliminary paper in which this fold was mentioned) he might have anticipated Locy in his discovery. Some observations are recorded upon the formation of the pulmonary organs, but, from reasons not apparent in either figures or text, the author thinks that two appendages are concerned in the formation of each lung-book. It is, however, to be noted that his observations, so far as they go, show that the lung-books are in reality modified appendages, and support the hypo-

[1] Edited by Prof. Jno. A. Ryder, University of Penna., Philadelphia.

[2] Observations on the Embryology of Insects and Arachnids. By Adam Todd Bruce. Baltimore, 1887. 4to; 9x31x17 pp.; 7 plates and portrait.

thesis of Lankester of the homology of the lungs and tracheæ of spiders with the gills and gill-appendages of Limulus.

Among the conclusions which are drawn, the following are worthy of note. The yolk-cells of hexapods and spiders are regarded as the true endoderm, but their purpose is the digestion of the yolk. The functional endoderm is of later origin, and forms the epithelium of the digestive tract. Spiders and the Merostomata are allied to each other, and differ from other arthropods in the absence of antennæ. The tracheæ of hexapods and of spiders are not homologous; for in the one they are clearly modified appendages, while in the other they occur on segments where well-marked appendages exist.—*J. S. K.*

The Development of Crangon.—In continuing my studies of the ontogeny of Crangon, I find the following points worthy of presentation, apart from my complete paper, soon to be issued. The blastopore, contrary to my previous statement, never becomes completely obliterated, but persists, and later an in-pushing takes place from the same spot and gives rise to the proctodæum.

The anus is at first *dorsal* in position, and attains its ventral position later by an outgrowth of the telson.

In front of the anus are a number of large budding-cells, both ectodermal and mesodermal, and from these are budded off new cells, which give origin to the segments of the body. They contribute largely to the nervous system and myotomes, and in them occur the only cases I have seen of karyokinesis in Crangon. They may be compared with the mesoblasts and neuroblasts of the leech, as described by Dr. Whitman.

The alimentary tract proper is wholly of *ectodermal* origin, the proctodeal and stomodeal inpushings, giving rise to all of it. The endoderm of invagination forms first migratory yolk-cells, which metabolise the yolk, and, later, arrange themselves to form the epithelium of the so-called "liver" or mid-gut gland of Frenzel.

The green gland is of mesodermal origin, as maintained by Grobben, and not of ectodermal, as described by Reichenbach and Ishikawa. This allows of its comparison with the segmental organs of the annelids. These points will be fully illustrated in the complete paper.—*J. S. Kingsley, Bloomington, Ind.*

PHYSIOLOGY.[1]

NOTES ON THE PREPARATION OF NUTRIENT GELATINE AND AGAR.–The practical worker in Bacteriology deplores the loss of time usually attendant upon the preparation, and especially upon the filtration of nutrient gelatine and agar. The method formulated by Koch and closely followed by most workers, is very satisfactory in producing good, clear culture media, but a few modifications render the procedure a much less formidable one, and as the changes to be suggested are simply those of detail, it may be well to state in brief the method now in use in this laboratory, which after considerable trial gives uniform and satisfactory results.

One pound (½ kg.) of finely chopped beef, as free as possible from fat and gristle, is mixed with 1000 c. c. of distilled water and kept in a cool place for 12 or 18 hours. It is then strained, cold, through a coarse cloth, into a wide-mouthed "agate ware" or "enameled iron" vessel of sufficient size, and 5 gm. of C. P. sodium chloride, 10 gm. of pepton,[1] and 100 gm. of gelatine[2] (or 10 gm. of Agar) are added. This is then placed in a water bath[3] (to which a large handful of rock salt has been added, if agar is to be prepared) and the gelatine (or agar) melted as rapidly as possible. The fluid is then neutralized by the careful addition of sodium bicarbonate in solution, and the boiling continued for a few minutes after, in order to precipitate the phosphates.

The fluid is now cooled by running water, to such a temperature as will not coagulate the white of egg, yet not enough to solidify it, when the whites of two eggs, thoroughly beaten up are mixed with it, and the whole boiled for half an hour.

Filtration which has usually been effected by means of filter paper, can be much more rapidly performed by the use of *absorbent cotton in large quantity.* The pores of the paper become clogged by the fine precipitates and by the cooling of the medium, and even with the use of the "hot funnel" the filtration is sometimes very slow. Cotton, on the other hand, presents in its meshes a much larger surface for the entanglement of the fine precipitates, and when used in large quantity, allows the gelatine (or agar) even when not very hot, to flow through it rapidly. The preparation of the filter is as follows: The absorbent cotton is unrolled, and sterilized in bulk in the hot-air chamber, care being taken not to char it. A six-inch

[1] This department is edited by Prof. Wm. T. Sedgwick, of the Mass. Institute of Technology, Boston, to whom brief communications, books for review, etc., should be sent.

[2] *Comte fils Gelatine premiere qualite*, gives excellent results.

[3] *Pepton Sicc. Extra*, from G. A. Hesterberg, Berlin, is used, as it imparts no color.

[4] The form that has been found most convenient is known as an agate ware "Milk or Rice boiler."

(15 ctm.) glass funnel is packed full with the dry sterilized cotton, placed in in layers, in such a way as to keep it well out of the neck, and having no folds nor ridges of cotton next the glass, through which the precipitates might pass into the receiving flask.

The neutralized culture medium, after being boiled with the white of egg, as above described, is strained through coarse flannel into a flask, and poured slowly upon the centre of the filter until the cotton is thoroughly soaked, and the fluid begins to run into the flask below. This moistening causes the cotton to sink considerably, and packs it in the funnel, and when packed, the fluid filters through it almost as rapidly as it is poured into the funnel. The funnel is now filled and the fluid filtered as fast as it will run through. The first filtration seldom produces a clear medium, but through the same filter the fluid may be poured again and again, each time becoming clearer, and the moderate cooling which necessarily occurs, does not sensibly retard the rapidity of filtration. When filtration is completed, a considerable portion of the medium entangled in the filter can be saved, by pressing upon the cotton with a sterilized glass rod, gently at first and near the sides, then in the centre and with considerable force. The gelatine or agar pressed from the cotton is sometimes cloudy, for which reason it is well to catch it in a separate flask.

It not infrequently happens that gelatine which filters clear precipitates phosphates on boiling; and that agar, on cooling, forms a flocculent precipitate. To insure against filling tubes with such media, it is safest always to fill one tube with the medium, and by first cooling, then by boiling and again cooling, to test the permanence of the transparency obtained. Should these precipitates form, it will be necessary to boil the gelatine in the flask, and to refilter it through a small plug of dry cotton placed in a funnel; while agar should be allowed to completely solidify, when it is again melted and filtered through a small plug of cotton. The media are now ready for tubing and sterilizing in the usual way.

The large quantity of absorbent cotton used and the considerable amount of medium lost, by remaining entangled in the meshes of the cotton (this may amount to 200 c. c. for each of the large cotton filters employed) are unquestionably objections to this method of filtration, but in its favor it may be stated that one filter when properly packed, serves to clear a large quantity of medium, and the great saving of time in filtering, enables one to prepare a large amount of these nutrients at one operation, which may be stored for future use. Futhermore, the "hot funnel" is dispensed with.

The modifications here described may be best appreciated by the fact that they render it possible to prepare within three hours several litres of the above-mentioned culture media.—*T. M. Cheesman, Jr., M.D.* (From the Bacterial Laboratory of Alumni Association of the College of Physicians and Surgeons, New York City.)

PSYCHOLOGY.

THE MONKEY AS A SCIENTIFIC INVESTIGATOR.—In the very interesting little "zoo," which now forms quite an attractive department of the National Museum at Washington, there is a fine male grivet monkey (*Cercopithecus erythrœa*), who shares a large cage with four opossums. Although he has a bad record as a fighter and biter of human beings, he takes kindly to his strange companions, and they have been the best of friends from the first. He spends many an hour in searching the fur of the opossums, and always sleeps with them in the family bed of straw. A few days ago the attention of the attendant was drawn to the monkey cage by the excited behavior of the crowd in front of it, and on going to ascertain the cause a strange and ludicrous sight was revealed to his astonished gaze.

In the middle of the cage sat the monkey, holding one of the opossums in his lap, with her belly uppermost, and her head under his arm. She submitted quite passively, far more so than when the attendants had previously made a similar examination. The monkey had just discovered the marsupial pouch of the opossum, and was diligently investigating it. Had he not been a close observer it certainly would have remained unseen, for it was so tightly closed as to be perfectly invisible in its normal condition. The monkey carefully lifted the outer wall of the pouch, and peered into the cavity. Then he reached in with his hand, felt about for a moment, and to the astonishment of everybody took out a tiny young opossum, about two inches long, hairless, blind, and very helpless, but alive and kicking. Jock held it up to the light, where he could get a good view of it, scrutinized it with the air of a savant, and presently returned it to the pouch, very carefully. After replacing it he looked into the pouch again, and presently drew out another for examination, which he looked at with solemn interest, smelled of it, and then carefully put it back. It was thus it became known to the attendants that the old female opossum had the young ones, which had previously been looked for in vain. —*W. T. Hornaday.*

ARCHÆOLOGY AND ANTHROPOLOGY.[1]

The Anthropological Society of Washington held its 138th regular meeting May 1st. Mr. W. H. Holmes, who has divided his talents about equally between science and art and been successful in both, read a paper entitled "Some Primitive Phases of Æsthetic Development." He directed his remarks principally to art in American prehistoric pottery. He said these earthen vessels were the outgrowth of natural form, finally acquiring decoration. This pottery was originally moulded in a basket or wicker-work (having the appropriate shape), thus giving to the soft clay the impressions of the woven meshes. When the vessel was burned these formed the decoration. This method of decoration seems to have been afterwards replaced by another, in which the cloth or wicker-work was either wrapped about or its figure cut into a wooden mould or form which was pressed on the outside of the vessel. A notched wheel was sometimes used. Some of the decorated vessels were shown, as well as some of the paddles used. These were, however, all modern Indian work.

Another paper was by Dr. W. J. Hoffman, on "Pictography and Shamanistic Rites of the Ojibwa." This tribe belongs to Minnesota. It has three distinct secret societies. The Grand Medicine Lodge is the most important. Each lodge has a high priest, who is charged with the preparation of candidates. There are four degrees. The rites occur in the spring, and the winter months are passed in study and preparation for the initiation. In addition to the practice of medicine the candidate must be instructed in the meaning of the characters on the sacred charts. The candidates who pass the four degrees are supposed to be gifted with the power of prophecy, of curing disease, and of prolonging life. Those who take but one degree usually manufacture the fetishes. Dr. Hoffman presented a number of original charts, not the sacred ones, from this tribe, showing the use of the characters, their meaning, and the method of translation. He also exhibited enlarged copies of charts which he had copied, sometimes surreptitiously, while among these Indians.

GUAJIRO is, according to Dr. A. Ernst, of Carácas, the correct form of the name of the Guajiro Indians inhabiting the South American peninsula called after them. In 1870 that explorer published his treatise on the Guajiro Indians in the *Zeitschrift für Ethnologie*, and since then their language, customs, and social institutions have been explored and described by various authors. From manuscripts of the United States consul Plümacher, at

[1] This department is edited by Thomas Wilson, Esq., Smithsonian Institution, Washington, D. C.

Maracaibo, a sketch of their customs and sociology was published in 1888.[2] Before this, Rafael Celedon, director of the seminary at Santa Marta, wrote a grammar of the language, which was published by E. Uricoechea in Maisonneuve & Co.'s Linguistic Collection, Paris, 1888. In an appendix to that treatise, Uricoechea reproduced Ernst's vocabulary of Guajiro *without giving credit to the author* for it. Celedon's work was regarded as insufficient in several respects by Don Jorge Isaacs, who published his critical remarks and strictures in the *Estudio del lenguaje Guajiro.*[3] Ernst regards that treatise as a valuable contribution to the knowledge of these South American dialects. Celedon, however, asserted his position, and defended himself against Isaacs's strictures in another article of the same *Anales*, entitled *Gramatica Guajira*, 1887, pp. 491–515. It seems to us that these attacks were victoriously warded off in part, and no student of that language must fail to read the writings of both antagonists. Both are placing the Guajiro language among the Carib dialects, to which it undoubtedly belongs. Ernst himself expresses the opinion "that this tribe forms a fragment of the scattered Arrowak, or Aruak ethnic family, linguistically as well as anthropologically." He states that the word Guajiro also occurs on the island of Cuba, the farmers being called by this name there from guayu, *we* (in Arawak wáyu) in the Guajiro language. It is impossible to make a full extract of Ernst's valuable article, and we have to refer our readers to the paper itself. Celedon has recently published materials upon the Köggaba language, which is distantly related to Guajiro (Paris: Maisonneuve & Co., 1886), and spoken in the Sierra Nevada of Santa Marta.—*A. S. Gatschet.*

Contributions to Anthropology and Prehistorics of Bavaria.—The latest number of this celebrated periodical,[1] which is published by the Munich Society of Anthropology, does not lag behind its predecessors in elaborateness and scientific importance. The curious subterranean gangways and corridors, which occur in a large portion of Würtemberg, Bavaria and Austria, were first explored and described between 1830 and 1840. Among the rustics many fairy and hobgoblin tales circulate on their account, these spirits being called *Erdleutl*, *Erdweibl*, *Schratzeln*, *Ratzeln*, *Wichtelen*, *Alraune*, *Weiberl*, and many other names, and represented as industrious and very bashful little beings. Some of these corridors take their starting-point from old castles, churches, mansions and their cellars, even from buildings now used as breweries, and parson's dwellings. Dr. Aug. Hartmann has published his results on this part of archæology in the exhaustive article "Unterrdische Gänge," pp. 93–129, stating that many other investigators are now engaged on this subject, and expect to publish their results in due time. Major C. Popp describes the Roman *castellum*, which formerly stood on a height near Pfünz, on the Altmühl River,

[1] Ausland of Stuttgart, January, 1888.

Bavaria.[1] Julius Naue continues his instructive enumeration of collective tombs or ancient cemeteries discovered between the Ammer and the Staffelsee, Bavaria. They all belong to the bronze and iron periods, and many of them are Roman. Some walls found near Uffing are of the cyclopean type and built of undressed stones. About thirty stone-graves are represented in the illustrations, many of them showing the body *in situ.* A physician of Tölz, Dr. M. Höfler, has composed a statistic memoir on "Cretinistic Changes observed with the Living Population of the District of Tölz," pp. 207–257. All cretinistic dispositions and alterations are deduced by the author from climatic causes. Among the characteristics of cretinism various authors are enumerating the pug-nose, prognathism, great distance from one eye to the other, bad condition of the teeth, small stature, lateness of the puberty period, weakness of the vocal and auditory organs, imbecility, goître, struma and scrofula. The geological formations which show the largest number of strumous individuals residing upon them are all of *marine* origin, as marine sandstone, eocene, keuper with marine shells. A map of the district, which lies upon the Isar River, is added to show the dissemination of the population affected with strumous diseases and complications.—*A. S. Gatschet.*

FOLK-LORE—HOW THE LIZARDS WERE ONCE LITTLE MEN. Mr. L. L. Frost, of Susanville, Lassen Co., California, tells us how, when he requested an Indian to gather and bring in all the arrow-points he could find, the Indian declared them to be "no good," that they had been made by the lizards. Whereupon Mr. Frost drew from him the following lizard story:

There was a time when the lizards were little men, and the arrow-points which are now found were shot by them at the grizzly bears. The bears could talk then and would eat the little men whenever they could catch them. The arrows of the little men were so small that they would not kill the bears when shot into them, and only served to enrage them. At last there was a smart little fellow who lived with his grandmother. One day he was making a bow and his grandmother asked him what he was going to do with it. He replied that he was going to kill a bear. His grandmother told him the bear had killed all his family, and so she refused her consent for him to go hunting, and kept him prisoner in the *campooda.* But the boy knew of a valley near by to which the bears came every evening to feed. He had finished his bow and gathered up his arrows, and when one day his grandmother went for water he stole away to this valley, and, climbing a tree, waited for events. Pretty soon a number of bears came into

[1] Anales de la Instruccion publica, Bogotá, 1884, vol. VIII., pp. 178–352, especially pp. 216–241.

[2] Vol. VII., Nos. 3, 4, illustrated.

[3] The name Pfünz is evidently derived from Lat. *pons* or *ad pontem,* "at the bridge," though the author is silent on this point.

the valley, and the little fellow whistled. At this the big boss bear which had killed so many of the little men, and of which all were afraid, came under the tree, and sitting himself on his haunches, looked up and asked the little fellow what he was doing up there. To which the little fellow replied, that he was going to kill him, the big boss bear. This reply tickled the bear so that he began to laugh, and making a great guffaw, opened his mouth so wide that the little fellow could see far down his throat, when quick as lightning he drew his bow and shot one of his arrows with one of these little points on it down the open throat of the bear and into his vitals, whereupon his laugh turned into a roar as he fell down, rolled over, and died. All the rest of the bears took to their heels and scampered up the valley and over the mountains. The little fellow went home and related what he had done, but his grandmother refused to believe him. But the next day the whole settlement gathered to hear the story, and all hands going to the valley, found the dead bear. This made the little fellow a great hero. Ever since that time the bears have hid away in the brush, and are afraid of men. Thus they have lost their power of speech.

The Indian could not tell how the little men became transformed into lizards.

SCIENTIFIC NEWS.

—Professor Amos H. Worthen, State Geologist of Illinois, and Curator of the State Museum of Natural History, died on Sunday, May 6th, 1888, at his home in Warsaw, Illinois, of pneumonia, at the age of nearly seventy-five years. For over thirty years he had been constantly engaged in the survey of, and in writing and publishing the reports upon the geology of his adopted State. He was born at Bradford, Vermont, October 31st, 1813. He was the son of Thomas Worthen, his mother being an Adams of Revolutionary and Presidential stock, and he was the youngest, save one, of a large family of thirteen children. He received his education in the common schools of his native town, and at Bradford's then famous academy. At an early age, before arriving at his majority, he married, January 14th, 1834, Miss Sarah Kimball, of Warren, New Hampshire, whose death occurred a little over a twelve-month ago. He emigrated to Kentucky in August, 1834, and in June, 1836, removed to Warsaw, Illinois, where he made his permanent home. With his brothers-in-law, the Kimball boys, or one of them, he became first a forwarding and commission merchant, and later dealt in dry goods at Warsaw. In 1842, influenced by the depression in business caused by the Mormon difficulties in Hancock county, he removed with his family to Boston, Massachusetts, returning in July, 1844, to Warsaw. Before going to Boston

his attention had been strongly attracted to the geological features of his new home, and the living forms preserved in the sedimentary rocks of that region, and especially its geode beds had commanded his admiration and close investigation. He gathered and took with him to Boston several barrels of "geodes," and there exchanged them for a cabinet of sea-shells, which he brought back with him to Warsaw. Similar forms to these shells he saw everywhere preserved in the limestone rocks of his locality, and every spare hour found him with his hammer and satchel exploring the ravines and bluffs and every exposure that could be reached. His collection grew apace, and soon began that extensive system of exchanges with other scientists which early made his collection so valuable as to command the attention of Professor Hall, geologist, first of New York and then of Iowa, and he secured from Professor Worthen the loan of many of his specimens with which to illustrate the first volumes of his reports on the geology of Iowa, the palæontology of which he placed in charge of Professor Worthen. Prior to this time, in February, 1851, a law had been passed authorizing a geological survey of Illinois, and two years later an appropriation was made for the purpose of carrying it out, and Professor Norwood was appointed geologist. Professor Worthen did some work under him, but soon engaged in more active work in Iowa under Professor Hall. On March 22d, 1858, Governor William H. Bissell, of Illinois, placed in the hands of Professor Worthen his commission as State Geologist, nothing of prior work coming to his hands except a report by Professor Norwood on the lead mines of Hardin county, and the field notes of his assistants. On taking charge of the survey, Professor Worthen at once proceeded to those active labors in the field which resulted in the publication of the magnificent series of eight quarto volumes of reports which are well known wherever geology is studied. He was assisted in this work especially by Professor J. D. Whitney in mineralogy, Professor Leo Lesquereux in coal measures and coal plants, Professor F. B. Meek, Mr. O. St. John, and Dr. John S. Newberry in different departments of palæontology, Dr. J. V. Z. Blaney in Analysis, and Mr. Henry Engleman first in detailed county surveys, and later in the chemistry of the survey. Professor Worthen's son, C. K. Worthen, aided greatly by furnishing the drawings for the numerous admirable engravings which so fully illustrate the reports. Professor Worthen was a man highly esteemed by all who knew him for many admirable qualities. He left six sons and twenty-two grandchildren.

—George F. Atkinson, Professor of Entomology and General Zoology in the University of North Carolina, has been appointed Professor of Botany and Zoology in the University of South Carolina, and *ex officio* Botanist and Entomologist to the State Experiment Station. His address after September 1st will be Columbus, S. C.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Indiana Academy of Science, May 1 to 4, 1888.—The Academy held a field meeting at Wyandotte Cave, some thirty-five members attending. The party gathered at Paoli on the evening of the first, when papers were read by Mr. James E. Humphrey, of Indiana University, upon Asa Gray, and by Dr. John M. Coulter, of Wabash College, upon the Discovery of the Yellowstone Park. From Paoli a wagon ride of thirty miles brought the party to the cave. On the return trip the newly-discovered Marengo Cave was visited, which all agreed was superior in all except extent to Wyandotte Cave. It was the universal opinion of the Academy that the accommodations and table of the Wyandotte Cave Hotel cannot be too strongly criticised.

Biological Society of Washington, April 7, 1888.—The following communications were read:—Capt. J. W. Collins, "The Work of the Schooner Grampus, in Fish Culture;" Mr. Chas. D. Walcott, "Cambrian Fossils from Mount Stephens, Northwest Territory of Canada;" Prof. C. V. Riley, "Some notes from Emin Pasha's Travels in Central Africa;" Dr. Theobald Smith, "The Destruction of Pathogenic Bacteria in the Animal Organism."

April 21, 1888.—Mr. F. W. True, "The Affinities of the White Whale;" Dr. C. Hart Merriam, "A Bat new to the United States, and New Localities for other North American Mammals;" Prof. C. V. Riley, "Notes on Platypsyllus."

May 5, 1888.—Prof. R. E. C. Stearns, "Instances of Mutations in Specific Distribution among Shells;" Mr. C. L. Hopkins, "Notes upon Pollenation of the 'Navel' Oranges;" Dr. C. Hart Merriam, "Description of a New Meadow Mouse, with remarks on the Subgenus Pedomys;" Prof. Lester F. Ward, "On some Characteristics of the Flora of the Potomac Formation."

May 19, 1888.—Mr. F. W. True, "The Hawaiian Bat"; Mr. Wm. T. Hornaday, "Man-Eating Crocodiles"; Dr. C. Hart Merriam, "A Revision of the *Dipodidæ*"; Mr. F. A. Lucas, "The Affinities of *Chamæa*."

Boston Society of Natural History.—April 4, 1888.—Mr. Samuel Wells read a notice on the Life of the late Richard C. Greenleaf; Mr. Robert T. Jackson read a paper on "The Development of the Oyster, with Remarks on Allied Genera."

April 18, 1888.—Professor Alpheus Hyatt read a sketch of the life of the late Spencer F. Baird, and Dr. Charles Sedgwick Minot exhibited the new automatic microtome which he has invented and which has now been placed on the market. The committee on nominations of officers for the year 1888–89 was presented and accepted.

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CULTURE AND SCIENCE.

BY THEODORE GILL.

A SHORT time ago, it will be remembered, an English gentleman, eminent as a classical scholar, and as a man of refined and æsthetic tastes, otherwise culture, delivered a lament in this city on the decadence of literature and the usurpation of science. He whom we are wont to call, without titular prenomen, Matthew Arnold, has long enjoyed the esteem of all English-speaking peoples, and I think that I can safely say that scientific men generally commiserate with the eminent *littérateur* in his evident grief, although they must equally generally fail either to discover the ground for his prognostications or to dread the impending dilemma. The Cassandraic laments of the apostle of culture have long been re-echoing throughout Great and Greater Britain, and his latest utterances were essentially the repetition of the wailings poured out into the sympathetic ears of the select Cantabrigian scholars and published broadcast in the *Nineteenth Century* some eighteen months ago (Aug. 1883, pp. 216–230). What his feelings were then and long before are thus told by him.

"'*No wisdom, nor counsel, nor understanding, against the Eternal!* says the Wise Man.' Against the natural and appointed course of things there is no contending. Ten years ago I remarked on the gloomy prospect for letters in this country, inasmuch as while the aristocratic class, according to a famous dictum of Lord Beaconsfield, was totally indifferent to letters, the friends of physical science to the other hand, a growing and popular body, were in active revol against them. To deprive letters of the too great place they had hitherto filled in men's estimation, and to substitute other studies

for them, was now the object, I observed, of a sort of crusade with the friends of physical science—a busy host important in itself, important because of the gifted leaders who march at its head, important from its strong and increasing hold upon public favor.

"I could not help, I then went on to say, I could not help being moved with a desire to plead with the friends of physical science on behalf of letters, and in deprecation of the slight which they put upon them. But from giving effect to this desire I was at that time drawn off by more pressing matters. Ten years have passed, and the prospects of any pleader for letters have certainly not mended. If the friends of physical science were in the morning sunshine of popular favor even then, they stand now in its meridian radiance. Sir Josiah Mason founds a college at Birmingham to exclude "mere literary instruction and education;" and at its opening a brilliant and charming debater, Professor Huxley, is brought down to pronounce their funeral oration. Mr. Bright, in his zeal for the United States, exhorts young people to drink deep of 'Hiawatha;' and the *Times*, which takes the gloomiest view possible of the future of letters, and thinks that a hundred years hence there will only be a few eccentrics reading letters and almost every one will be studying the natural sciences—the *Times*, instead of counselling Mr. Bright's young people rather to drink deep of *Homer*, is for giving them, above all, 'the works of Darwin and Lyell and Bell and Huxley,' and for nourishing them upon the voyage of the 'Challenger.' Stranger still, a brilliant man of letters in France, M. Renan, assigns the same date of a hundred years hence, as the date by which the historical and critical studies, in which his life has been passed and his reputation made, will have fallen into neglect, and deservedly so fallen. It is the regret of his life, M. Renan tells us, that he did not himself originally pursue the natural sciences, in which he might have forestalled Darwin in his discoveries."

Are Mr. Arnold's representations respecting the attitude towards literature on the part of the advocates of physical science literally correct? Are they not exaggerated? Most certainly the curriculum of Sir Josiah Mason's Science School does not exclude literary instruction, but only such as the sole objective end, and Professor Huxley happily anticipated the objection made on the occasion referred to by Mr. Arnold. As I have elsewhere[1] shown, in a review of Professor Huxley's Science and Culture, he fully recognizes the urgency of literary culture, and simply deprecates an

[1] The Critic (New York).

undue attention to the neglect of more practical studies. On the occasion in question he merely reiterates them; and to those who would urge that want of cultivation of the ancient languages and literature entails narrowness of thought, he replies that "the advocates of scientific education might fairly enough retort upon the modern Humanists that they may be learned specialists, but that they possess no such sound foundation for a criticism of life as deserves the name of culture. And, indeed, if we were disposed to be cruel, we might urge that the Humanists have brought this reproach upon themselves, not because they are too full of the spirit of the ancient Greek, but because they lack it." Nevertheless, he afterwards says, he is "the last person to question the importance of genuine literary education, or to suppose that intellectual culture can be complete without it. An exclusively scientific training will bring about a mental twist as surely as an exclusively literary training." He thinks that there is no need, however, that such a catastrophe should happen. Instruction in English, French and German, such as is provided for in the Mason Scientific School, renders accessible "the three greatest literatures of the modern world," and if an Englishman cannot get his literary culture out of his Bible, his Shakespeare, his Milton, neither will the profoundest study of Homer and Sophocles, Virgil and Horace, give it to him." These opinions are valuable as emanating from one who in his own person combines scientific and literary culture of no common order.

But what is culture? From the writings of Mr. Arnold, as well as from the observations of those who are generally conceded to be "men of culture," I infer that it has, in the opinions of such, a narrower range than is admitted in the dictionaries of the English language. Therein we learn that culture is "the application of labor or other means to improve good qualities or growth;" or, "specifically, any training or discipline by which man's moral and intellectual nature is elevated; or, "the result of such training, enlightenment, civilization, refinement." Further, we learn that "the word culture has made its way among us from Germany mainly through the influence of Goethe, and that "we speak now of the culture, whether of a nation or individual, as a kind of collective noun for all that refers to the higher life."

But it appears that such definitions are too latitudinarian and vague. According to the special culture-worshippers, it seems that certain things must be done and certain other things left undone to entitle to entry into the fold of culture. For example, above all

things the Latin and Greek languages and literatures must be mastered, for the main object in life must be to make and understand classical allusions, and there can be no more grievous sin against culture or more glaring evidence of want thereof than not to understand every inuendo or allusion made in polite converse which springs from a classical source; not only ancient but modern poetry must be read, and not only read but enjoyed (this too is essential), and the principles of metric composition understood; otherwise will the failing individual incur the charge of lack of culture. With a touch of pity Mr. Arnold recalls that "Mr. Darwin once owned to a friend that for his part he did not experience the necessity for two things which most men find so necessary to them—poetry and religion; science and the domestic affections, he thought, were enough."

On the other hand, a very limited knowledge or even ignorance of things practical or natural is tolerable from one who has the positive qualifications specified. Even mathematics has entered too largely into the curriculum of the universities of England, and Mr. Arnold, for instance, declared on the occasion of his address here noticed, that "if in the Cambridge Senate House one may say such a thing without profaneness, I will hazard the opinion that for the majority of mankind a little of mathematics, also, goes a long way. Of course this is quite consistent with their being of immense importance as an instrument to something else; but it is the few who have the aptitude for thus using them, not the bulk of mankind."

Many there are and many must there be who will object to the restriction of the term culture as thus advocated. In fact, the issue, so far as Mr. Arnold is concerned, is not between culture and science, but between a one-sided attention to classical studies and certain departments of science. The alternatives, as they appear to Mr. Arnold, are expressed in the following terms:—

"A certain president of the Section for Mechanical Science in the British Association is, in Scripture phrase, 'very bold,' and declares that if a man, in his education, 'has substituted literature and history for natural science, he has chosen the less useful alternative.' Whether we go to these lengths or not, we must all admit that in natural science the habit gained of dealing with facts is a most valuable discipline, and that every one should have some experience of it.

"But it is proposed to make the training in natural science the main part of education, for the great majority of mankind at any

rate. And here, I confess, I part company with the friends of physical science, with whom up to this point I have been agreeing. In differing from them, however, I wish to proceed with the utmost caution and diffidence. The smallness of my acquaintance with the disciplines of natural science is ever before my mind, and I am fearful of doing them injustice. The ability of the partisans of natural science makes them formidable persons to contradict. The tone of tentative inquiry, which befits a being of dim faculties and bounded knowledge, is the tone I would wish to take and not to depart from. At present it seems to me, that those who are for giving to natural knowledge, as they call it, the chief place in the education of the majority of mankind, leave one important thing out of their account —the constitution of human nature."

That important element to the constitution of human nature, we elsewhere learn. A knowledge of all nature (and man is a part) is the domain of Science, but still, we are told, "it will be knowledge only which they give us; knowledge not put up for us into relation with our sense for conduct, our sense for beauty, and touched with emotion by being so put; not thus put for us, and therefore, to the majority of mankind, after a certain while unsatisfying, wearying."

I cannot forbear, in this connection, to once more cite Mr. Arnold. In his Cambridge address he recalled to his auditors a certain utterance of his of the past.

"Some of you," he said, "may have met with a phrase of mine which has been the object of a good deal of comment; an observation to the effect that in our culture, the aim being to know ourselves and the world, we have, as the means to this end, to know the best which has been thought and said in the world."

But to know only the best, however desirable—and it is supereminently so—is only to very imperfectly know the world and human nature. And the experience of many in this audience will attest to the fact that idiosyncracies are only partially controlled by education. Many classical students,—many who have passed with honor out of our colleges after having pursued the entire curriculum of the humanities—have shown a lack of morality and integrity all the more glaring because of their culture, and I doubt not that some of you may recall those whose scholastic training has been ripe but yet who have ended their career in a prison cell. Some of those who have thus lapsed have done so in consequence of the inaptness of their furniture for the struggle of life. There are those of

them too, I know, who have charged their incomplete lives to that insufficiency of a collegiate course for the practical end of existence. This insufficiency has become so patent to many that they have demanded a change in the college curriculum, and this demand has come less from those interested in scientific pursuits than from those who have contemplated from outside the triumphs of science and have desired its advantages to be more feely extended and opened. The advantages of a scientific training are so evident that they need not be urged. In the words of Mr. Arnold, "the great results of the scientific investigation of nature we are agreed upon knowing, but how much of our study are we bound to give to the processes by which those results are reached? The results have their visible bearing on human life. But all the processes, too, all the items of fact, by which those results are established, are interesting. All knowledge is interesting to a wise man, and the knowledge of nature is interesting to all men."

It is in view of this conceded usefulness of science and its relations to everyday life that there is an ever-increasing demand on the part of comparatively disinterested lookers-on to force it into college. This demand, as before indicated, is not so much from the acknowledged representatives of science as from the general community, and men of science interpose ever to moderate the demand and to recommend the retention of what are called the humanities in the educational course. They urge that it is not the part of science or true culture (which amount to almost the same thing) to reject the one and to devote attention alone to the contemplation of gross matter. They are satisfied to give room and time, so far as may be possible, to all knowledge, and they do not find fault even with those who, like Mr. Arnold, think that "if there is to be separation and option between humane letters on the one hand and the natural sciences on the other, the great majority of mankind, all who have not exceptional and overpowering aptitudes for the study of nature, would do well to choose to be educated in humane letters rather than in the natural sciences. Letters will call out their being at more points, will make them live more.

"And, indeed," continues Mr. Arnold, "to say the truth, I cannot really think that humane letters are in danger of being thrust out from their leading-place in education, in spite of the array of authorities against them at this moment. So long as human nature is what it is, their attractions will remain irresistible. They will be studied more

rationally, but they will not lose their place. What will happen will rather be crowded into education other matters besides, far too many; there will be, perhaps, a period of unsettlement and confusion and false tendency; but letters will not in the end lose their leading place. If they lose it for a time, they will get it back again. We shall be brought back to them by our wants and aspirations. And a poor humanist may possess his soul in patience, neither strive nor cry, admit the energy and brilliancy of the partisans of physical science, and their present favour with the public to be far greater than his own, and still have a happy faith that the nature of things works silently on behalf of the studies which he loves, and that, while we shall all have to acquaint ourselves with the great results reached by modern science, and to give ourselves as much training in its disciplines as we can conveniently carry, yet the majority of men will always require humane letters, and so much the more as they have the more and the greater results of science to relate to the need in man for conduct, and to the need in him for beauty."

There is much in these utterances of Mr. Arnold which can be re-echoed by the man of science. Doubtless the exclusive status of the humanities in the educational curriculum has been lost beyond redemption; in some institutions, at least, they no longer take the lead, and above all, their study has been to some extent sanctified by scientific methods. But the enlightened chiefs of science, far from denying, claim a place for the humanities parallel with those of their own chosen departments. What they do propose, in response to popular clamor, is not to exclude classical studies, but to leave to those students who have matured sufficiently to face a near future the option of a course which may be most useful to them in their after careers. The knowable is only less measurable than the unknowable, but human capacity and life are finite. Grecolatry and Latinolatry are sometimes obstructive. The physician will have less use for a profound knowledge of the humanities than of humanity; the chemist or miner will doubtless find Greek and Latin of use, but much less than German or French and still less than an elementary acquaintance with matter. The future merchant may be glad to bandy classical allusions with his customers, but a knowledge acquired, in the schools, of the objects of his trade will save much cost and labor in those years when time and labor are of most account. Let all be allowed to elect those

studies which may be most useful to them in their chosen walks in life.

In coming time there must needs be a modification of educational methods for adaptation to the increasing ramification and development of the tree of knowledge; and if early youth is the best time for learning languages, so is it—and to even a greater degree—the best time for the cultivation of the logical and observing faculties. There must be sacrifice of some branch of learning, and what that shall be should probably be determined by the position of the individual and his tastes and aptitude. A technical education is at least more likely to be of future use to most persons than a classical one, and will certainly fit one better for the struggle of life, even if, as might be contended, it will be less apt to render him "philosophical" under its calamities.

I cannot forbear, even at the risk of being regarded digressive, to here interject some remarks respecting the place of the classical languages in general philosophy. We are constantly being told that the Latin and Greek are the most perfected and the highest developed of all tongues, and it is implied that others are less so to the extent by which they deviate from those stocks. I have no hesitation in utterly denying such a statement, and the claim in question is the result of that lack of broad culture which is incident to exclusive or undue attention to what is called a classical curriculum. The Greek and Latin languages really represent an immature although nearly adolescent stage of linguistic development, the former being nearer the primitive stage, while the latter is on the whole appreciably more advanced in natural development. The inflections, which have been claimed as a feature of excellence, in truth are characteristic of the youth of language and of barbarous peoples. Such nations, for example, as the American aborigines (Choctaws, Creeks, etc.) and the Eskimo, exhibit a complexity of inflection which is immeasurably in advance of the classical ones, and the same reasons which have been urged for the supremacy of Greek and Latin are applicable in a far higher degree to the Eskimo and Choctaw. The decay of inflections may almost be said to be in an inverse ratio to the healthy growth of expression, and we may justly claim, on scientific grounds, that of all languages, English is the most advanced in its developmental career, so far at least as differentiation of its elements is concerned. These utterances, although they may appear heterodox to some, I feel

assured will be challenged by no scientific philologist. It would be easy to justify them, but time forbids. I close, therefore, with some ideas as to the relations of Science and Culture.

Science is often personified as an aggressive being and even as a demon, shoving and pushing all else away and endeavoring to throttle and kill all else, that it alone may live and flourish. A falser conception is scarcely possible. This aggressive demon is not science, but a man of straw. Yet the disciples of theology and the apostles of culture seem to be made alike unhappy in their contemplation of the portentous and horrid offspring of their imaginings, and batter away at the impassive man of straw while complaining of his aggressions. Science is rather a goddess who is rich in attributes and ready to reward her worshippers, but coy in her gifts ; she is generous only to those who worship at her shrine in sincerity and truth, and who supplement their prayers by continual labor and deeds. To such she distributes her gifts much according to their deserts. Her worshippers are generally content with their several portions, and in her temple enjoy such sweet communion and peace of mind that they envy not the lots of those outside ; if at all solicitous for any outsiders they are actuated by motives of philanthropy and benevolence alone to invite such to share with them. What other possible motive can there be for proselytism? They repose in the temple, itself on an eminence above the turbid billows of popular boisterousness, and can contemplate without alarm the strife of faction and of sects below. The outcries and assaults against science are, therefore, without justification, and are evidently the outcome of jealousy and rivalry among the worshippers at other shrines; those interests appear to be imperilled, and they dread popularity so manifested by the number of votaries wending their way in ever-increasing throngs to her temple. Such pilgrims, however, are not unthinking followers of aggressive and proselytizing apostles, but are attracted by the clear atmosphere of the heights on which the temple is perched and by the gifts which the goddess half conceals and only imperfectly exhibits to new disciples.

Near her portals, there are no runners who clamor to all in view to come in and believe as they do or be killed and damned. The priests who guard her shrine warn those that would approach to come *not* save they are prepared to cast off their garments of prejudice and to test all things by trained sense, experience, and reason.

Her votaries are not forbidden to doubt what is uttered in her temple; doubt as encouraged as a prelude to faith.

Science is most catholic in her regards, and none are denied entrance to her temple who submit to her laws. Conditions are imposed, it is true; but all those who give obedience to the few conditions are admissible. One of the conditions is that common sense intensified shall be applied to all questions. If it is the historian, he must learn to doubt and to weigh the statements handed down from posterity; if the Greek or Latin scholar, he is refused, not because of his Greek and Latin as taught in the schools, but because only so knowing he knows too little and too imperfectly; when he has gained increased knowledge and breadth of view so that he knows his language as a harmonious part of a great whole, he, too, is eligible. Science takes cognizance of all nature and all the outcome of nature. How, then, can there be any antagonism between science and culture when true culture is only an esteemed and devoted offspring of science? Any antagonism between the two is as causeless and insensate as the revolt of the members against the body imagined in the ancient apologue.

ON THE GROSS ANATOMY OF CAMPELOMA.

BY R. ELLSWORTH CALL.

THE collection of a large number of specimens of *Campeloma subsolidum* Anthony, in the Des Moines river, Iowa, in early August, presented opportunities to somewhat carefully study the coarser anatomy of the genus as exhibited in this species. The results of this study are herein given. It may be noted, as introductory, that an unexpected closeness of structure to that of the foreign genus *Paludina* was developed, and, further, that the general diagnosis given by Dr. Stimpson[1] will need some slight emendation, particularly in respect to certain external characters, and in respect to the lingual teeth and the branchial laminæ.

External Characters.—In the living and recently dead animal the color of the foot-mass is light lead or bluish white. Viewed from above, the cervical lappets, foot, operculigerous lobe, tentacles and proboscis are further enlivened by irregularly scattered bright orange-yellow dots. These dots are, on the tentacles and proboscis, arranged in somewhat regular transverse rows, giving a barred appearance to each. These last-named organs are, moreover, marked by an abundant deposition of black pigment immediately under the cuticular membrane. The under surface of the foot, the crawling disk, shows, in living specimens, the large longitudinal pedal muscles. When these muscles contract, in the act of withdrawal into the shell, the anterior margin of the disk is reflected upwards and backwards over the proboscis and tentacles. This reflected portion is, as a whole, then bent backwards and downwards to be finally covered by the posterior portion of the foot, the upper surface of which carries the operculum. The whole mass is then withdrawn into the shell. During the period of reproduction, when the organs devoted to that function are in a condition of marked activity and distension, the animal, especially of the female, cannot be wholly retracted. In this respect it resembles most of our large *Helices*.

Sexual Features.—The sexes are readily distinguished, in life, by means of the right tentacle, which, in the male, is very much larger than its fellow and rather more curved outwards (Plate VII., Fig. 2,

[1] Smithsonian Misc. Coll., No. 144, p. 35, 1865.

and VII. of Fig. 1, in the text). Again, as appears below, the shells differ in certain particulars of corresponding dimensions.

The male seminal duct is displayed throughout nearly its whole length by clipping the mantle along the extreme left of the branchial chamber. The *vas deferens superior* (IV., Fig. 1) arises from a point on the anterior left third of the testis (II., Fig. 1). This latter organ is placed immediately under the right duodenal fold of the intestine (I., Fig. 1). It is about three times longer than wide, and whitish in color. The *vas deferens superior* after passing anteriorly to a point near the anal extremity of the intestine is suddenly bent obliquely backwards and traverses the floor of the branchial chamber for a short distance, but soon turns forward again at a somewhat acute angle. At this point (III., Fig. 1) is the prostate. The *vas deferens inferior* (V., Fig. 1) is rather long, narrow, and nearly straight, and is continued along the floor of the right tentacle to the verge (VI., Fig. 1). The right tentacle thus becomes an intromittent organ in the process of copulation. This tentacle is somewhat flattened above, presenting, in cross section, an elongated ellipse. It is somewhat less in length than its left fellow, and is rather more curved outwards.

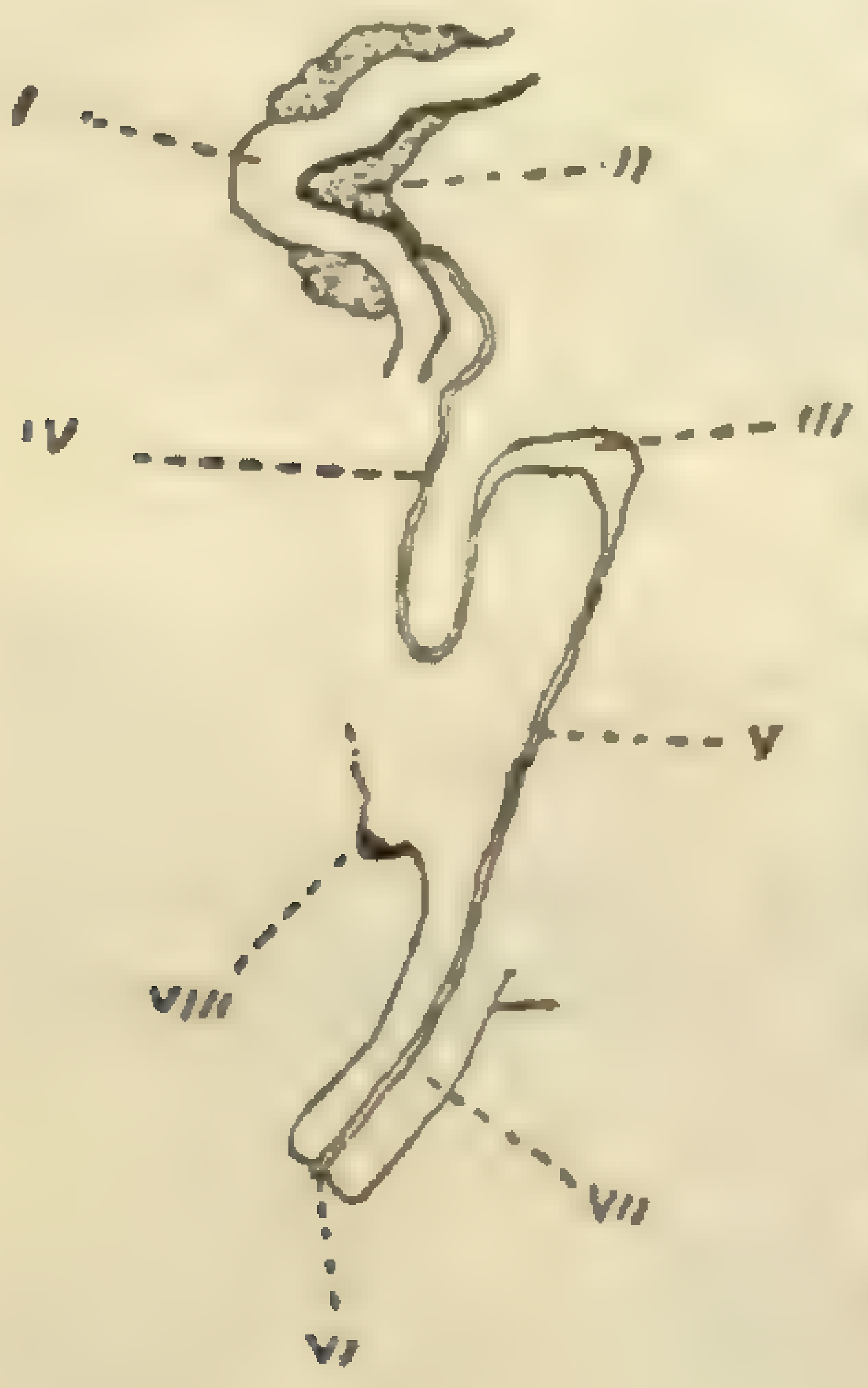


Fig. 1.

In the gravid female the gestatory sac (Plate VII., Fig. 5, c) occupies the greater portion of the body whorl on the right side. It is readily distinguished in the living specimen by the greater deposit of black pigmentary matter in its thin outer walls. Anteriorly the sac opens into a rather small duct, the mouth of which is prolonged into the branchial chamber about 2 to 2.5 millimetres (b, Plate VII., Fig. 5). This duct is guarded at each extremity by rather powerful sphincter muscles. Anteriorly the walls of the gestatory sac are slightly thicker and are modified into longitudinal folds or rugæ leading towards the duct. These possibly are of use in guiding the extrusion of the young.

During the summer and fall months, and often also in hibernating specimens, the gestatory sac is crowded to distension with young, in various stages of development (Plate VII., Fig. 5, c). Those most anterior are, in early August, nearly or quite through their prenatal growth, and are less closely crowded upon one another

than are those in the rear portion of the sac. All the young in the anterior portion possess shells. The shell of the young at

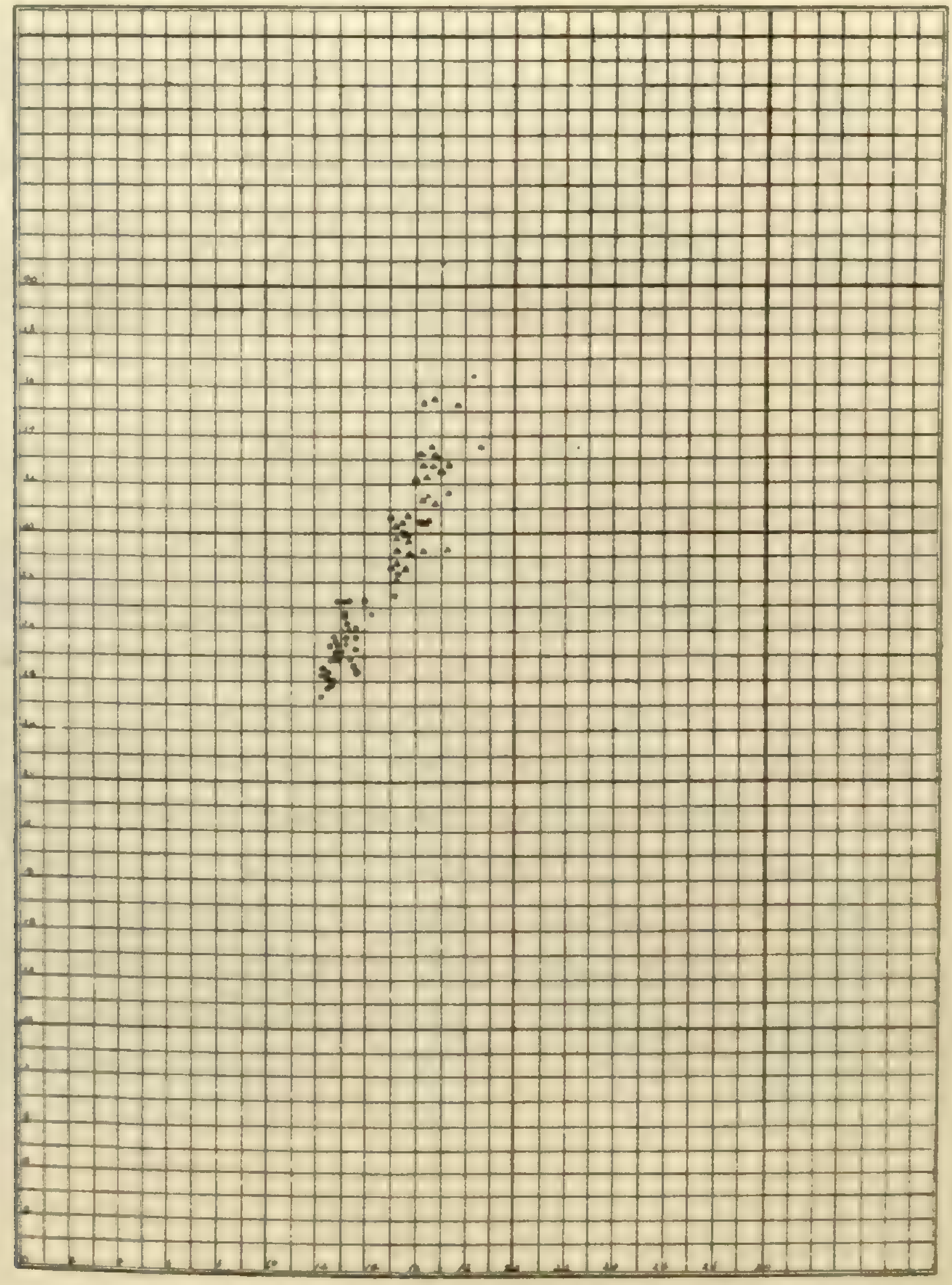


FIG. 2.

this stage is devoid of *colored* epidermis, is crystalline white, and possesses from 2 to 2½ complete whorls. The apex is very short and blunt, the first whorl being nearly uniform in diameter throughout its length, while the body whorl is very large, comprising fully nine-tenths the entire bulk of the shell. The darker tentacles and the black eyes at their outer base are readily seen through the substance of the shell. The average dimensions of a dozen or more young examined were, for length 3.5 mm., for diameter 2.96 mm. The embryonic whorls never, so far as experience goes with mature specimens with completely preserved apices, acquire the characteristic green epidermal coloring.

The number of young is variable, the large mature specimens containing, as might be expected, the greater number of young shells. Twenty specimens were carefully examined with a view to this feature, with the following result:—

Specimen.	Young.	Specimen.	Young.	Specimen.	Young.	Specimen.	Young.
1	36	6	59	11	29	16	47
2	42	7	52	12	25	17	42
3	51	8	32	13	49	18	64
4	35	9	32	14	58	19	63
5	41	10	38	15	34	20	50

These twenty individuals, therefore, present an average of forty-three young.

Aside from the tentacular differences which exist between the male and female, both tentacles of the latter being uniformly subulate, a further sexual difference appears in the greater size and somewhat more globose character of the female shell. Coördinated with this difference in dimensions is the more shouldered character of the whorls in the female specimen, a difference connected with the position and necessarily large size of the gestatory sac. The males are more regularly conical, with rather less oblique aperture, and are of considerably less globose appearance than are the females. This difference was supposed to be of value in determining the sex when only the shell was at hand. To test it as a sexual differential character, thirty-six of the largest males and an equal number of the largest females were selected from a finding of more than a gallon of *C. subsolidum*, taken on August 6, 1887, and were carefully measured. The results appear in the following:—

TABLE OF DIMENSIONS. MALES.

No.	I.	II.	No.	I.	II.	No.	I.	II.
	mm.	mm.		mm.	mm.		mm.	mm.
1	25.88	12.80	13	24.94	12.92	25	24.22	12.36
2	26.00	13.00	14	24.52	12.38	26	25.14	13.00
3	27.25	13.32	15	26.10	13.51	27	23.90	12.70
4	26.06	13.31	16	30.76	15.00	28	26.62	13.12
5	27.22	12.90	17	27.34	14.00	29	23.94	12.86
6	26.80	13.14	18	24.95	13.36	30	25.84	12.92
7	27.47	15.08	19	27.32	13.04	31	26.16	13.29
8	25.50	12.66	20	26.86	14.20	32	25.16	12.92
9	24.48	12.54	21	25.76	13.62	33	25.50	13.60
10	25.54	12.90	22	25.20	13.61	34	23.36	12.24
11	26.28	13.40	23	24.82	13.50	35	24.95	12.88
12	24.14	12.50	24	28.32	15.22	36	24.00	12.64

I. = length in mm. II. = diameter in mm.

TABLE OF DIMENSIONS. FEMALES.

No.	I.	II.	No.	I.	II.	No.	I.	II.
	mm.	mm.		mm.	mm.		mm.	mm.
1	36.44	18.40	13	35.50	17.72	25	29.20	16.22
2	30.00	15.68	14	30.30	16.29	26	29.10	15.80
3	29.80	15.16	15	32.37	16.40	27	32.88	16.34
4	32.12	16.00	16	30.50	15.56	28	30.24	16.60
5	32.92	16.88	17	28.50	15.68	29	23.94	12.86
6	30.26	16.21	18	33.14	16.80	30	25.84	12.92
7	30.44	15.50	19	29.49	17.32	31	26.16	13.29
8	33.62	18.62	20	30.00	15.50	32	25.16	12.92
9	35.28	17.62	21	31.64	17.36	33	25.50	13.60
10	29.88	15.72	22	33.14	16.16	34	23.36	12.24
11	33.50	16.60	23	35.40	17.32	35	24.95	12.88
12	32.50	17.00	24	30.42	16.56	36	24.00	12.64

I. = length in mm. II. = diameter in mm.

A comparison of ratios shows the numerical values of differences, as follows: Length of male to its diameter, $\frac{25}{13}\frac{789}{234}$; length of female to its diameter, $\frac{31}{16}\frac{35}{127}$; length of female to length of male, $\frac{31}{25}\frac{35}{789}$; diameter of female to diameter of male, $\frac{16}{13}\frac{127}{234}$. The differences of lengths is 5.561 and of diameters 2.893. It would appear, then, that this degree of difference may be of diagnostic value in the matter of sex. The diagram, Fig. 3, is designed to present this sexual peculiarity in a graphic form. The marginal numbers represent millimetres. The ordinates represent the lengths, and the abscissas, which have the same scale, represent diameters. The circular conventional sign represents the male and the triangular character the female specimen. The average dimensions of each group are represented by the open conventional sign with its distinguishing sex mark conjoined. It will be seen that while the dots fall into two pretty well-defined groups, the range of greatest variation follows the ordinates, and that this range is comparatively greater for the female than for the male form. In other words, the males are more constant in lengths and vary less in diameter, while, for the female form, differences in length are measurably compensated by corresponding increase in diameter.

Fig. 3

In connection with this character it may not be altogether amiss to call attention to certain so-called species which have been based upon the males of *C. subsolidum*. They are *Campeloma milesii* Lea,

C. coarctatum Lea and *C. exilis* Anthony. The same unfortunate cause of synonomy has led, in the genus *Unio*, to the erection of more than a hundred spurious species, in certain cases the females serving as a basis for not less than five specific names. The *form* of a shell in so extremely variable a group is certainly a very misleading character.

Digestive Organs.—The buccal cavity opens on the middle side of the rather short proboscis near its base. Near the œsophagus (III., Fig. 3) and upon the floor of the buccal mass lies the radula. This is a small, narrow, chitinous organ, beset with numerous transverse rows of teeth, arranged according to the formula 3.1.3 (Fig. 3, Plate VII., and Fig. 4). The dentition is therefore tænioglossate. On either side, near the posterior end of the buccal cavity, open the ducts of the salivary glands (II., Fig. 3). These are small racemose paired glands, dirty white in color, and lie close upon the œsophagus. Including their ducts, they are about 1.5 mm. in length, and nearly or quite .25 mm. in width. The œsophagus is long, irregularly winding, placed upon the floor of the branchial cavity, and opens, into a somewhat capacious stomach (IV., Fig. 3), near the middle of the whorl next the body-whorl. The intestine is of nearly the same size as the œsophagus, and does not enlarge until the opening of the biliary duct is passed (V. and VII., Fig. 3). At this point it is coiled upon itself to the left, forming what may be called the right duodenal fold, immediately under which lies the testis, as stated above. Turning again to the right, it is there directed forward, becomes slightly enlarged, forming the rectal portion of the intestinal canal (VIII., Fig. 3), which opens into the branchial cavity near the margin of the mantle on the right side (IX., Fig. 3). The liver (VI., Fig. 3) is a very large glandular body, completely filling the first two and a half to three whorls of the shell. Its contents are discharged into the duodenal portion of the intestine near the position of the heart. In color it is orange-red, and is somewhat larger and darker in the male than in the female form. This organ, like all other portions of the animal which lie next the shell, is inversed by a thin membrane, containing pigmentary matter, the membrane itself being a continuation of the mantle.

Respiratory Apparatus.—The branchial cavity is large, extending backwards throughout nearly the whole length of the body-whorl. It opens towards the right side, its left margin being just

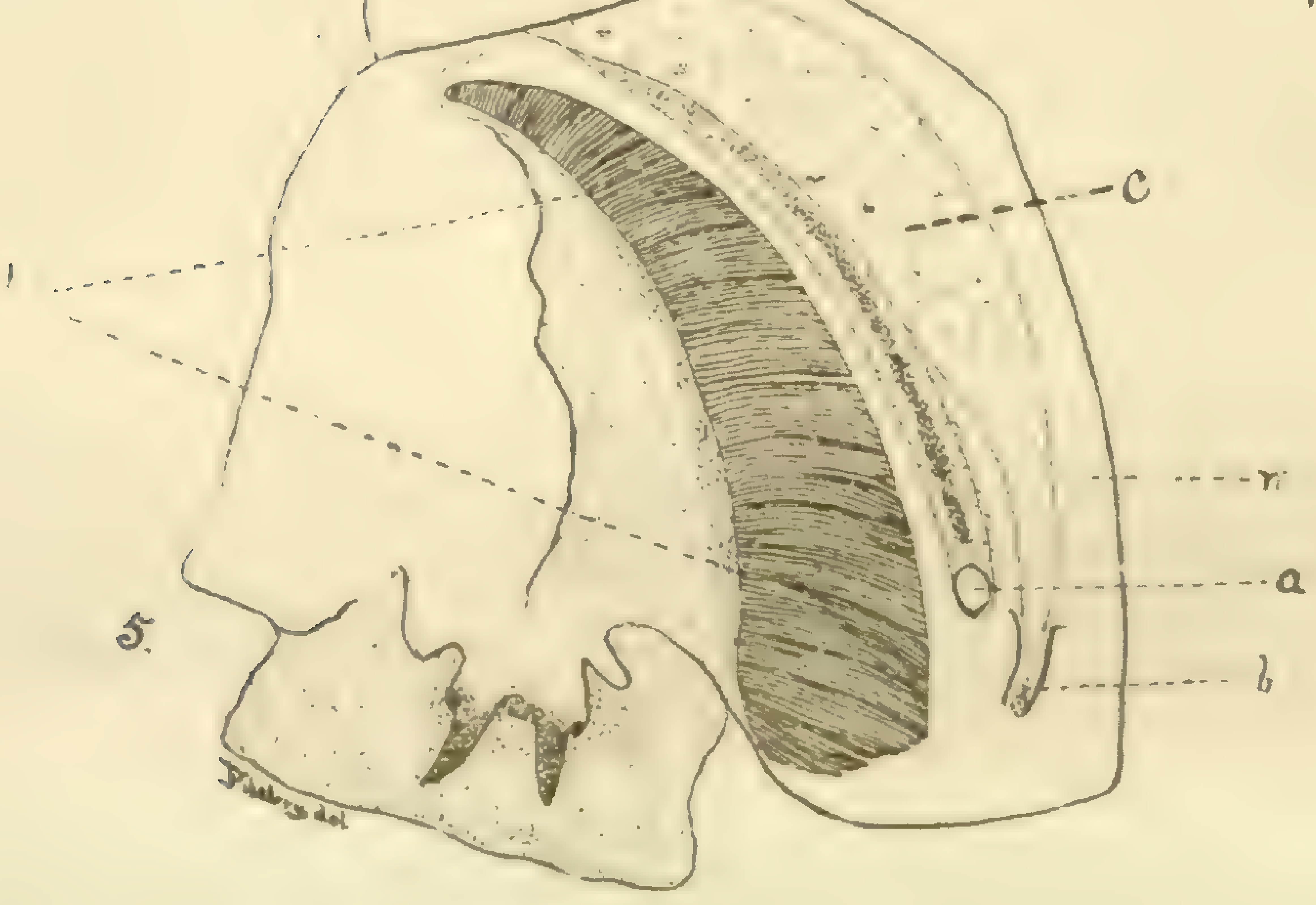
PLATE VII.

1.

2.

3.

4



5.

above the base of the left tentacle. The chamber is somewhat less in size in the gravid female than in the male, a fact the explanation of which probably lies in the distension of the gestatory sac and its consequent encroachment upon the branchial space. The chamber narrows rapidly posteriorly, and becomes laterally constricted. From its upper and left side walls is pendant the ctenidium (Plate ? Fig. 5, Br). This organ consists of a single row, containing a great number of thin elongately triangular plates, connected above with the branchial vein. The right edge and lower extremity of each plate is free, and each is constantly bathed with water. The plates become smaller as the rear end of the chamber is reached; they are yellowish white in color, and are furnished with abundant cilia. The blood, which is aerated in these plates, is white.

The attention of students with proper appliances at command is directed to these molluscs in respect to their embryology, nervous system, minute anatomy of the reproductive organs, myology and circulatory system. Only the crudest observations on these points were possible under the conditions which were presented to me, and such facts as were ascertained are repressed in the hope that some other one will be able to complete the work here outlined.

Explanation of the Plate.—$\times \frac{4}{3}$. All the figures, save Fig. 2, are drawn from the female. The mantle is clipped along the left margin of the branchial cavity.

Fig. 1. Female, Fig. 2, male individual.
Fig. 3. A single transverse row of teeth.
Fig. 4. Odontophore, natural size and very greatly enlarged.
Fig. 5. Anatomy of the branchial cavity with related organs.
a. Rectum and anus.
b. The opening of the gestatory sac, c.
br. The ctenidium.

The figures on the plate were drawn by Mr. H. A. Pilsbry from dissections made by him. Those in the text are drawn, somewhat diagrammatically, by the author, from nature.

THE WILD CATTLE OF GREAT BRITAIN.

BY R. C. AULD, F.Z.S.

THERE has always been a great deal of interest manifested in the lay as well as in the scientific mind as to the wild cattle of Britain. The British Association appointed a committee to inquire into the condition of these herds, and at a late meeting this committee's report was presented by Canon Tristram. The herds at present existing were stated to be those at Chartley, Chillingham, Cadzow, Somerford, Blickling, and Vaynol. The last (near Carnarvon) does not seem to be mentioned by Storer or Harting.

The committee thought it would be extremely interesting if the noble owners of the three ancient herds—Chartley, Chillingham, and Cadzow—would co-operate with some other owner of a large park, if haply such could be found, willing to undertake the following experiment: All calves which would ordinarily be converted into veal or steers should, instead, be sent to build up a new herd, which, combining the blood of the only remaining ancient herds and with no artificial selection exercised, might be expected to revert more nearly to the aboriginal wild type than could be achieved in any other way.

The care with which the European bison is preserved in Poland, under the especial protection of the Czar of Russia, has been noted. The interest of the Russian and British "quality" from the earliest date in taking means to preserve these aboriginal animals is most praiseworthy and contrasts favorably with the apathy of Americans in regard to their aboriginal bison. Why should not the American Association take this matter in hand, and, ere too late (if not, indeed, too late already), secure from government a regional reservation and sufficient enactment that would ensure the preservation of this interesting species?

Some of these wild British herds were horned; most were polled. Some of them became domesticated; most of them became extinct. Their antiquity cannot be limited; they were among the original cattle of the island—indeed, descendants of the Uri that roamed into this corner of Europe before it became an island.

But some do not care to trace the origin of British cattle further than the historical dates of the subjugation of the various parts of

the island by Roman, Norseman, Dane, and Norman. The student who has devoted himself unremittingly to this historical aspect of the question is the Rev. G. Gilbert, of Claxton, Norwich. The views of this gentleman, who has paid much attention to the history of the polls, are worthy of study, and it is here appropriate to refer to them. I do so by quoting extracts from several communications I have been favored with from him: "My own opinion," he writes (and he begins by referring to the Aberdeen poll) "is that there was in Scotland, on the east coast, long before the short-horn struggled into notoriety, even in England, herds of polled cattle which owed their best qualities of hardiness and combined power of producing good beef and milk from the same animal to that very breed which gave these properties to the short-horn—*i.e.*, to that big polled white which seems to me to have come to Great Britain above eight hundred years ago with the Baltic Rovers, and to have existed in considerable numbers, in places widely apart, down to the beginning of last century without there having been any recent connection.

"The polled herds in England, Scotland and Ireland all held, before there was much intercourse between cattle-men, one common infusion, and that was the blood of the whites from the far north. Those white cattle seem to have parted with their color more readily than they parted with their thick muscle (*i.e.*, lean flesh), tending to milk, hardiness, and polled heads. (Of course recently, since 1750, there have been large transmissions of English cattle to Scotland, and *vice versâ*, and also of English and Scotch cattle to Ireland. I doubt if ever before this century either England or Scotland has ever borrowed sires from Ireland, though England has borrowed for quite a century Scotch sires, and Scotland English sires for the same period.) Gradually, at the end of the last century, distinct types of those county herds which all had some ingredients common and, each, some distinct element, got more or less fixed, until they reproduced themselves, as they do now, even in non-pedigree stock, with tolerable certainty. I fancy the last half of last century saw the formation of *all* British breeds now existing in distinct form. The short-horns and all the polls hold the largest infusion of the big white, the Midland and Hereford hold the most of the old South Europe longhorn, whilst the Devon, Kerry, and small North Highlander hold the most of the type known as *Bos longifrons*, all of which seem to have been the first domestic cattle in Great Britain and Ireland.

"I think that very likely *Bos urus* was already in both islands as a wild beast. But *Bos urus* and the big white are not the same. The big white was domesticated from the first, and probably came, as you yourself suggest, from the polled breeds of India. I am trying to gather all the evidence I can get to show what the last thousand years may have done to make British breeds what they are, and thence to infer what the thousand years before that may have contributed. The long-horn, as I fancy, came over with the Romans, and the white polls with the Danes long subsequently. It was through the working of this Danish introduction that all the polled breeds took their rise. I fancy during the Wars of the Roses in England and up to the time of the union with Scotland breeding cattle was pursued without any aims beyond these:—

"1. Certain districts tried to get big oxen for labor.

"2. Other districts avowedly preferred the smaller cattle, as better able to live in the huts with their owners.

"Through these influences, up in the mountains, the smaller or (*Bos longifrons*) North Highland type kept its ground. In the plains and near the towns the cattle became larger, partly from selection, partly because their veins were filled with many intermixtures. Bulls would come from the south as baggage animals in the track of returning armies and would be crossed with and enlarge the native cows. So all through the richer lands on the south and east side of Scotland there was not any fixed type for a century or two as there was in the north and the west. But still it was these cattle of the plains (I believe) which originated the 'doddies.'

"Wherever the Dane (white polled) extended itself it broke the colors—first conveyed the disposition to throw occasional polled calves. The disposition to produce polled calves and the mixing colors are evidences of latent (perhaps very remote) connection with the Danish introduction.

"It would be absurd to suppose that the Danish introductions were all that we now regard as 'pure bred'—*i.e.*, all alike and entirely of one descent. Probably there were a few cherished white herds in the north of Europe kept to one type; but, more likely, the cattle were early mixed through the predatory habits of the red-rovers. The Danes may have brought over here a few pure whites, gifts to their chiefs; but they brought over far more which were carried off by their vessels from shores on which they touched

after leaving home but before they reached Britain; so that the Danish additions to Scotch and English breeds were not one but many. Still, it was among their introductions that their tendency to polled calves was brought to this island, and it came from the far north, where, even in the days of Herodotus, its existence was noticed. Before Herodotus we only find traces of it in rock sculpture in the far Orient. Thousands of years ago the polled form was developed (as I think) in India, and it worked its way thence to the shores of the Baltic overland through centuries of slow advances. From the Baltic it found its way to England and Scotland. I do not think from England to Scotland, or *vice versâ*, but that the same set of sea-rovers introduced cattle with polled tendencies into both countries almost simultaneously."

It should be stated that the above was written before the publication of Victor Hehn's work (already noticed), in which the latter traces the polled cattle of Western Europe to Scandinavia and the White Sea. Mr. Gilbert takes the history of these continental polls a step farther, following them, it will be seen, to the eastern coasts of Great Britain, landing them with the Baltic invaders, to become the determining element in forming the polled races now existing in Great Britain, whether north or south of the Tweed. "These," writes Mr. Gilbert, "probably were our latest introductions." Hence the polled breeds on the eastern coast would have had prior origin. The various British and foreign forms Mr. Gilbert thus indicates must be studied as a whole in connection with the appearance in Europe of the various hordes who reached it by two routes: *First*, by the northern route, descending upon Mid-Europe from the shores of the Baltic. *Second*, by the southern route, making their way upward, men and cattle, along the shores of the Mediterranean.

The question has raged to which species these wild cattle belonged? Professor Low says of these animals: "The wild breed, or, as it may be termed when domesticated, the white Forest breed —identical with the ancient Urus—is still preserved in a few parks, where the animals, herding and breeding only with one another, retain their pristine characters. Numbers, however, existed in the domesticated state in Wales until late in the last century. . . . Scattered individuals are yet to be met with, as in the County of Pembroke, in no respect distinguishable from the wild cattle of the parks."

J. E. Harting, F.L.S., F.Z.S., the latest scientific authority who has given attention—and that in a most thorough manner—to the wild white cattle, says, in his *British Animals Extinct*, page 214: "The weight of scientific opinion, however, seems to favor the view that these wild cattle were descended from the Urus, either by direct descent through wild animals from the bull, or, less directly, through domesticated cattle deriving their blood principally from him."

Rütimeyer, Nillsson, Lyell, Darwin, and Boyd-Dawkins believe that our wild white cattle are descended from the Urus in one or other of the two ways above indicated; while Owen and Dr. J. A. Smith ("Notes on the Ancient Cattle of Scotland," in *Proc. Soc. Antiq. Scotl.*, Vol. IX., p. 587) hold a different view, and consider that *Bos primigenius* became extinct throughout the whole island in prehistoric times. "This may have been the case," says Harting, "in southern parts of Britain." But he indicates conclusively that this could not have been the case in undisturbed Caledonia.

In Ireland "no trace of these wild cattle has been discovered, although remains of the smaller *Bos longifrons* have been procured from some localities."

The late J. Gibson, of the Museum of Science and Art, Edinburgh, Scotland, writing on "Cattle" in the *Encyclopædia Britannica* (ninth edition), says: "*Bos taurus*, var. Scoticus, makes the nearest approach of living forms to Urus, represented by Cadzow, Chillingham, Lyme, and Chartley herds."

These herds have been preserved since early historic times. The pictures by famous artists—such as Ward, Landseer, and others—represent them faithfully.

BRITISH WHITE POLLED CATTLE.

Rev. John Storer's work[1] is the most exhaustive we have on the subject of the wild white cattle of Britain, while J. E. Harting, F.L.S., F.Z.S., editor of the *Zoologist*, has published a more concise account.[2]

The following is a tabular view of the various herds:—

[1] Wild White Cattle of Great Britain.
[2] Extinct British Animals.

British Wild White Cattle (Bos urus).

I. Horned Variety.

1. Sub-variety, having black ears, but no black tip to tail.
   Chartley, Drumlanrig,[1] and Athole[1] Herds.
2. Sub-variety, having red or brown ears, but no black tip to tail.
   Chillingham and Lyme[1] Herds.

II. Polled Variety.

English Herds.

(*a*) Somerford,[2] Cheshire—Black points.
Wollaton,[2] Nottinghamshire—Black points.
Burton Constable,[2] Yorkshire—Black points.

(*b*) Gisburne,[2] Yorkshire—Red or brown points.
(Whalley Abbey.[2])

(*c*) Middleton,[1] Lancashire—Black and dark brown or red points.
Gunton,[1 2] Norfolk—Black and dark brown or red points.
Blickling,[2] Norfolk—Black and dark brown or red points.
Woodbastwick,[2] Norfolk—Red and dark brown points.
Brooke,[1 2] Norfolk—Black and brown or red points.

Scottish Herds.

(*d*) Ardrossan,[1] Ayrshire—Black and brown or red points.

(*e*) Hamilton, Lanarkshire—Black and brown or red points.

The polled herds, it will be seen, have been and are still the more numerous, and a short description of each is appended.

ENGLISH HERDS.

I. THE SOMERFORD PARK HERD, near Congleton, Cheshire, is a domesticated herd, but its cattle are very characteristic, having all the peculiar features of the White Forest breed. It is certainly of great, though unknown, antiquity, their owner, Sir Charles Shakerly, saying: "We have no history of how they came or how long they have been here. I am of the third generation which has

[1] Extinct. [2] Domesticated.

known nothing about them. The tradition is that they have been here two hundred years." It is probably the best representative extant of the hornless and tame variety of the originally wild white breed. It is of great importance, as showing what and of great value the numerous ancient herds of white polled cattle were. Perfect and in working order, it gives an excellent idea of what the Gisburne (now extinct) and the Hamilton (now horned) cattle were originally. This herd seems to be a connecting link between the domesticated white cattle and the wild, and also between those which had horns and those which were polled. An experienced eye cannot fail to trace a very close resemblance between them and the wild horned breed at Chartley. The park is well timbered, the quality of the soil and grass very good, though in the heart of the ancient forest region. The milking properties of the cows are good naturally, and have thus been fully developed. The white color of the cattle is accompanied by black points, and sometimes spots on the neck and body. They are handsome and very uniform as to color. They may have been derived from some ancient monastery, one of which, Vale Royal, only twelve miles distant, has a somewhat similar breed. Storer gives a very full account of them as they existed at the time of his visit to the herd in 1875.

FIG. 1.—Head of White Bull, with black ears and muzzle, of Gunton Herd. (From Storer's *Wild White Cattle of Great Britain.*)

II. WOLLATON HALL HERD,[1] the property of Lords Middleton, situated three miles west from Nottingham, has become extinct during the last fifty years. It was generally known as "the Old Park Breed," which indicated them to be an original and very ancient race. They were polled and had black points. The originally wild nature of the herd interfered with its thorough domestication, in-breeding hastening its extinction, as in many other park herds. They were of specially large and symmetrical proportions. Their pasturage, of considerable extent, was fairly good, though not particularly rich. They are supposed to have become enclosed from the grand old forest of Sherwood. The Wollaton (Somerford),

Chartley, and Lyme (these last two horned) formed the southernmost group of the ancient white cattle, and all were in tolerably close proximity.

III. THE GISBURNE PARK HERD,[1] the property of Lords Ribblesdale, situated in the Valley of the Ribble, in the district of Craven, West Riding of Yorkshire. This herd became extinct in 1859, the cause being in-breeding. They were described by Bewick in 1790 as perfectly white, except the insides of the ears, which were brown. They were thick and deep and as large as any short-horns, had mellow hides, and were excellent milkers. They are said to have been brought originally from Whalley Abbey, being enclosed from the indigenous wild cattle which occupied the great forests of Lancashire. Professor Boyd-Dawkins preserves in the Museum at Owen's College, Manchester, under his charge, the skull of "the last bull" of this herd. In a letter to me, referring to this, he says: "The Gisburne cattle come nearer to the Chillingham cattle than any other breed, being white in color, with reddish-brown inside their ears. The only stuffed specimen and skull of this breed, now extinct, are in the Museum under my charge at Owen's College, Manchester. The Gisburne breed represents, like the Chillingham, the domestic cattle of the Urus type which have never been confined in fields, and which, therefore, by contrast with the more domesticated animals, are frequently termed wild. The stuffed specimen above referred to is a cow, low in stature, with a prominent protuberance on the forehead, like that found in the Galloways. The skull, also hornless, and belonging to a bull, labelled 'The last of the ancient breed of wild polled cattle kept at Gisburne Park, Yorkshire, killed 11th November, 1859, and presented by the Rt. Hon. Lord Ribblesdale,' proves that the male was hornless."

IV. MIDDLETON HALL HERD,[1] the property of the Asshetons, Baronets of Middleton, near Manchester, Lancashire, was quite an original one, of very ancient origin. They descended from the wild bulls that invested Blakele, close to Middleton Hall. They gave origin to the Gunton herd, in Norfolk. Dr. Leigh mentions them in 1700 (*Natural History of Lancashire, Cheshire, and the Peak of Derbyshire*, Book II., p. 3). but the origin he traces for them—from the Highlands of Scotland—must be regarded as a mere surmise.

V. GUNTON PARK HERD,[1] the property of Lords Suffield, situated in the northeast portion of Norfolk. The Gunton cattle

were brought from the Middleton herd and were a continuation of it. The cattle became thoroughly domesticated. They had black, or, at any rate, dark brown, points. They were deep milkers. They gradually disappeared; but in their day they had great influence on the cattle of the district. The Rev. George Gilbert confirms this, and also as to their size. They "stood up like dray-horses," while they could be made enormously fat.

VI. Blickling Hall Herd (Norfolk) is a domesticated herd still existing. It was derived from Gunton. The cattle had black points. They were considerably affected by the rinderpest, previous to which they were very useful in the dairy. Rev. George Gilbert, who gives a full account of them in Storer's work, says the cows are not above the average of the Galloway and are below that of the Aberdeen. The following is the latest I have seen in reference to this herd, and shows that it contains good material: "A remarkable novelty at this Norfolk show was an exhibition of several animals from Lady Lothian's unique herd of white polled cattle, the beasts having black ears and points. A bull took a first prize, beating several fine Herefords. This curious herd has been kept at Blickling since the reign of Charles II., and it represents one of the oldest types of cattle in the world." (London *Truth*, July 7, 1887.)

VII. Woodbastwick Herd, the property of Mr. A. Cator, Norfolk, a domesticated, still existing herd, derived from Gunton. The cattle had red points. They were large, would fat to great weight, and had large manes. They were kept pure up to 1840, when different crosses were had resort to. It is of importance to note that Mr. G. Gilbert states: "It is impossible not to notice that the white polled cattle, both at Blickling and Woodbastwick, are quite distinct (in appearance) from the Norfolk and Suffolk. They are as distinct from the local polled variety as possible,"—and he also includes the Galloway and Aberdeen.

VIII. The Brooke House, or Kerrison Herd[1] (Norfolk), were a domesticated herd before they became extinct. They were derived from Gunton, and had black points. Rev. George Gilbert, by relationship with the owner of this herd (Sir Roger Kerrison), is very well acquainted with it. He states they stood very high, and that there are traditions of a similar breed of white polled cattle in the Downham district occasionally, even now, polled steers of gigantic size being occasionally found. He saw one in 1877 which

certainly stood six feet high. These cattle may have also been derived from the stock of one of the monasteries of the Premonstratensian Order, which had privileges over certain manors, including Brooke and Kustead, in both of which parishes Sir Roger Kerrison's ancestors lived. Mr. Storer, speaking of this herd, concludes his account thus: "It demonstrates by the clearest evidence how strong has been the influence of the wild forest breed upon our domestic cattle, how wonderfully persistent is the type, and how it reproduces itself under the most unlikely circumstances—often, perhaps, when its very existence is altogether unsuspected."

IX. Burton Constable Herd.[1]—This herd is situated in the Holderness or East Riding District of Yorkshire. Storer is not very definite about this herd as to its character. It appears to have been a polled herd. Bewick (1790) gives a brief account of it. He states it was carried off "a few years ago by a distemper." These cattle were much larger than the Chillingham horned cattle, many weighing sixty stones (eight hundred and forty pounds).

SCOTTISH HERDS.

X. Ardrossan Herd[1] (Ayrshire), property of the Lords Eglinton, was mentioned by Sir John Sinclair in 1814 as one of the then few remaining examples of Caledonia's ancient breed. It survived till about 1820. They had black points. They were enclosed about 1750. They were traditionally believed to have been horned when introduced to Ardrossan. They were certainly all, or very nearly all, polled within the memory of man. The cause of their becoming hornless was the result of an introduction from the polled Hamilton herd. In other respects they seemed to have differed little from the Caledonian wild cattle, except that perhaps they were smaller. Mr. George Robertson, author of several such works, in his *Description of Cuningham and Ayrshire*, published 1820, says: "They are altogether wild; they have no horns; they are distinguished by the name Caledonian," being an offshoot of the older Hamilton.

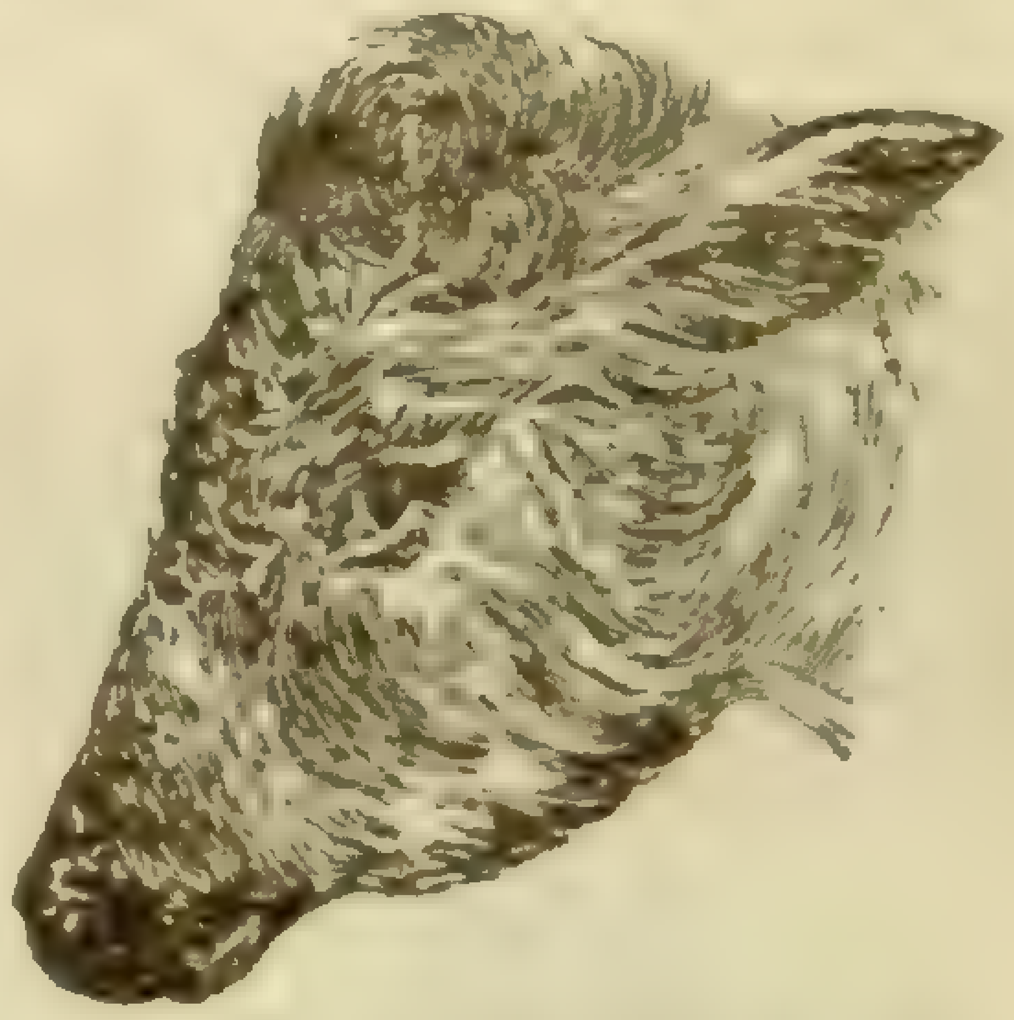


Fig. 2.—Head of Young Bull, *Bos scoticus*. (From Milne Edwards' *Zoology*.)

XI. The Hamilton Herd (Lanarkshire), known also by the names Cadzow and Chatelherault. Mr. Brown, chamberlain to the Duke of Hamilton, in Jesse's *Natural History*, describes

the Hamilton Urus as having a body dun white, with black points, and the cows as seldom having horns. Sir John Orde says that they were anciently "all polled." Youatt speaks of them as being polled, beginning his account of *The Polled Cattle* with a description of them. Mr. MacGillivray, in his *Essay on the Present State of the Outer Hebrides*, says: "A whitish dun color is also pretty frequently seen, not unlike that of the original wild cattle of Scotland, both the horned breeds at Chillingham, and the polled one at Hamilton, and it is remarked that in all their traditions or fables of what are called fairy cattle this is the color ascribed to these animals." At the sale of the late Dr. Knox's collections a polled skull of the Hamilton wild ox was purchased by the late Professor Goodsir. It was labelled by him *Urus scoticus*, and added to the Anatomical Museum of the University of Edinburgh. Some oxen from this herd were exhibited not many years ago at one of the shows of the Highland Society, and were similarly described. In Milne-Edward's *Zoology*, 1863, Figure 256, the "Head of young Scotch bull, *Urus scoticus*, or wild ox of Caledon, Cadzow," is polled. (See Figure 2.) The skull is labelled "White Ox of Scotland." From this testimony it is pretty clear that the Hamilton herd was originally polled. So late as 1852, W. C. L. Martin, in his book on *Cattle*, says the Hamilton's "are larger and more robust than the Chillingham. . . . The cows, and also the bulls, are generally polled or hornless." And in 1862 Charles Stevenson wrote: "In the herd of wild cattle in Hamilton Park polled bull and heifer calves frequently appear. Latterly no bulls are kept which have not the short white horn tipped with black; but there are a few cows and heifers polled. It may be mentioned that this breed was originally both polled and horned and that both types reappear, notwithstanding the care taken to breed them of a uniform type as to horns and color." Thus is shown the gradual change from *polled* to *horned*. The reason given of their having become horned is stated by Sir John Orde, Kilmory, Argyllshire, to have been from a Highland bull having accidentally got within the park. Some horned calves were produced, and by subsequent selection the herd had got horns generally, the horned character being preferred—likely from the fondness for the grandly-horned Highland cattle, which make such a picturesque feature of the Highland glens and straths. But their horns are "short," not "long." These celebrated polled cattle, variously known as the

Cadzow, Hamilton, or Chatelherault—the first name being the name of their forest home, the second being one of the Scotch titles of the ducal owners, the third being their French title—are thus generally regarded as being the remains of the ancient breed of white cattle which was found on the island when the Romans first visited it, and which they represent as then running wild in the woods. The universal tradition in Clydesdale, where they were called "Caledonian," is that they have been at Cadzow from the remotest antiquity, and the probability is that they formed part of the establishments of the early British and Scottish kings. Sir Walter Scott's stirring ballad on the hunting of the wild bull is too well known to need repetition.

THE CALIFORNIA GRAY WHALE.

(*Rhacheanectes glaucus* Cope.)

BY JOHN DEAN CATON.

I FIRST saw this interesting animal eighteen years ago, when running down the coast on the steamer Orizava. We then met them in considerable numbers when on their migration north. We were running but a few miles from shore, and generally observed them on the seaward side, but sometimes on the shore side. Sometimes they appeared quite close to the ship and did not seem to be much alarmed by the presence of the steamer. I have since taken pains to inform myself of the habits and mode of capture of this great sea mammal and think I may safely say that it is the most interesting of all the species of whale known to inhabit the great seas, perhaps because it is the best understood.

It does not inhabit the distant depths of the broad oceans but its habitat is confined to the coast line of the Pacific from Cape St. Lucas at the southern extremity of the peninsula of California to Behring sea and even into the Arctic ocean, where it sports among the icebergs of the north with as much apparent pleasure as it rolls and tumbles among the great breakers in its southern range.

If other species of whales are as strictly migratory as this we lack the evidence to prove it. If others wander about into different seas, and even go from ocean to ocean, they do not move with that

regularity and system which constitutes what we call migration. With these this habit is as regular as the recurrence of the season, and is no doubt as universal as is that of most aquatic birds.

Wintering in the south, this migration to the north commences in the spring, first with the males, who having no domestic duties or cares to detain them, leisurely proceed northward, and they are soon followed by the females with their young so soon as the latter are large enough to undertake the long journey. Not that either sex move in a body and together, for they are scattered along the coast for even months, though they generally move in schools of greater or less numbers, among which both males and females may occur. Undoubtedly the former were laggards, while the latter were of the advance of the females.

Of all the families of whales, of this alone has it been possible to study the breeding habits with satisfactory results.

Along the coast, in the southern part of their range, numerous lagoons are found indenting the shores, near the mouths or outlets of which, bars occur on which the surf breaks with great violence when the sea is rough, while the waters within are placid. These lagoons are the favorite breeding grounds of these whales, where they congregate in great numbers to bring forth their young, which occurs during the winter months, say from November till March. Although the fiercest fighters of all known whales it has not been known that they are quarrelsome among themselves. So far as known, peace and quiet prevails among all the members crowded together in the upper ends of these water enclosures or lying-in hospitals. But few males have been observed to intrude themselves into the privacy of these retreats. The period of gestation is said to be about twelve months, and from analogy impregnation takes place within a very few days after the young are brought forth. Eliott's exhaustive observations show that such is the case with the fur seals, whose period of gestation is the same. Indeed, this must be so, when the period of gestation nearly corresponds with the year, else there could be no regularity in the time when the young are brought forth, but it would occur irregularly at all seasons of the year.

Another peculiarity of this whale is its fondness for sport or play. While this habit is solitary it is distinctly manifest. Its favorite amusement is to sport in the breakers or the bars at the entrance to bays, lagoons and rivers, and the greater the breakers, the more do

they seem to enjoy them, for there they play and gambol about, increasing the foam by the use of their powerful flukes, sometimes fairly turning somersaults, while at others they will cease apparent exertion, allowing themselves to be rolled and tossed about, the passive sport of the angry waters.

Of all the known species of whales, this is the most cunning, courageous and vicious. So terrible is it, that with the old implements of harpoon and lance, but few whalemen would court an encounter with it, and it early received the name of the Devil Fish. I have no account that it ever maliciously attacked an unoffending object, yet when it found itself pursued where escape was difficult, even before it was struck, it has been known to turn upon pursuers and dash a boat to fragments with a single blow of its powerful flukes, and so has many a life been lost.

It was in the whale nurseries, in the retired lagoons, where the young were brought forth and nursed, for a considerable time after they were able to accompany their mothers for long distances out to sea, that the most terrible encounters occurred. The mother has a remarkable affection for her young, and will do and dare everything in its defence, hence the whalemen were cautioned not to strike the calf while the mother was living. If she would not resent a severe wound to herself, while there was yet hope for escape that she might live to nurse and take care of her offspring, when once her darling was injured her rage knew no bounds, and there was no escape from her but to run the boat into shallow water or upon the beach. It is said that when in port the masters of whalers, in convivial mood, each recounting his adventures and escapes, those among them who had ever pursued this whale, could silence all others when recounting the terrors of the chase, and would seek to rival each other in tales illustrating the ferocity and courage of the female when her young were in danger, and if the last in turn to come did not win the palm it was his own fault or rather his lack of inventive genius. This is the way the last one to relate his experience won the drinks. He said he was once pursuing an old cow whale, with a well-grown calf, and while he had cautioned the man in the bow not to touch the calf, the youngster presented so fair a mark that he could not hold himself and so let him have it. Knowing what would follow, he instantly ordered all hands to pull for the shore, which fortunately was not far off. As they saw the enraged dam bearing down upon them like a tornado when they reached the shore, they tum-

bled out of the boat and thought they were safe. But no, she pursued them on land as well, and never stopped till she had treed them all!

The danger of the pursuit was much lessened, and the chances of capture of these dangerous animals was much increased by the introduction of the harpoon-gun and the bomb-lance. By them the attack could be made at a safer distance, and the exploded bomb produced instant death.

The inshore habits of these whales made it possible for the natives to attack and capture them even with their rude implements but as I have met no account of this south of Washington Territory, and rarely except in the vicinity of the Strait of Fuca, it is not improbable that much of the belligerent disposition of the brute may have left him by the time he has pursued his migratory journey so far, and especially may the temper of the female have been improved when the defence of her offspring was no longer demanded. Their mode of capture was simple though ingenious, but could have only met with disaster in their southern breeding grounds. Their mode was to attack with a large number of canoes, each armed with several men and provided with a number of inflated bladders, or air-tight sacks made of skins; to each of these was attached a light strong cord, at the other end of which was an arrow When a whale was sighted, the swiftly-paddled fleet pursued and embraced every opportunity for hours to shoot their arrows into him, always throwing overboard the proper air sack. Soon these began to tell by impeding his course through the water and preventing him from diving to as great a depth as formerly and obstructing his progress when fleeing from his pursuers. Thus in a longer or shorter time he might be literally covered with arrows, and so obstructed and loaded down, so to speak, with the air sacks, that he became quite helpless and finally succumbed to his swarming enemies, when by their united efforts he was towed to the shore and utilized in their way. This was only rendered possible by the peculiar inshore habits of this species of the whale.

For many years this whale was hunted from large whaling ships, which were anchored at convenient places near those locations where observation had shown the animal was most likely to be found, and from the ships whale boats were sent out to hunt for the game, and when captured they were towed to the ship and treated in the ordinary way. But this was an expensive mode of maintain-

ing a whaling station, and as the objects of pursuit became scarce—notwithstanding the improved mode of capture by the use of the harpoon-gun and bomb-lance—the pursuit became unprofitable, when Yankee ingenuity proved equal to the emergency and shore whaling stations were thought of. These are built upon the shore in sheltered places, but commanding an extensive seaward view.

Convenient structures are erected and equipped with all necessary implements and apparatus, with boats and arms for the capture of the whale, and everything on shore for treating the captive when brought to the shore. Near the station was a high lookout upon which a watchman was stationed with a well-understood system of signals, by means of which he could telegraph the boats when far out to sea. Here the men built comfortable cabins where they lived with their families, and later, as the whales became scarcer, they could pursue other avocations when their time could not be employed in the pursuit of their prey, which intervals increased as the whales became less and less abundant, till now many of these shore stations have been entirely abandoned. Here, in Monterey, the first whaling station was established on shore in 1851, and later another was established, both of which did a successful business for years, but within the last few years they have been entirely abandoned. Some of the buildings still remain but they are fast going to decay, and the old whale boats may now be seen leaning up against the sheds useless and abandoned. So at Carmal mission, a few miles across the peninsula; the absence of the game has compelled its desertion, and this is now true of most of the many whaling stations along this coast which once flourished. The station near the mouth of the bay of San Diego, I believe, is still kept up; at least when I passed it three years ago I saw two whales were on the ways.

Altogether we may well fear that this interesting species of this great family may before many years become extinct, as did the sea cow (unless governmental powers shall interpose to save them), which existed in incredible numbers about Bering Island when the great navigator was cast upon it, and where he found his grave in 1741.

The California whale may make a bolder and harder struggle for existence than did the Rhytina, but it is rapidly going to utter extinction. While other species of the whale family have greatly diminished in numbers in all waters, still their habits protect them from final destruction. They have a wider range and cannot be

slaughtered on any exclusive breeding grounds. Here their nurseries are limited to particularly favored places which are known and accessible to all who choose to murder them, and it is a little remarkable that the State of California has not, long since, by stringent laws protected them, at least in the nurseries within her borders. If their capture were confined to the open waters of the ocean and to a reasonable distance from the mouth of the lagoons in which they breed, we might well hope to see them multiply rather than fade away to final extinction. Certain interests encouraged the extinction of the vast herds of buffalo which once roamed over the plains and even the forests of our country, that the ranchmen might have better pasturage for their stock, but no interest can be promoted by the destruction of this whale while great interests would be subserved by its protection and increase. Other animals are protected which are of no practical value except as mere spectacles, while their existence involves a positive loss by the destruction of vast numbers of food fishes.

I might have stated before, that the California whale, though not the largest of the family, is of a good size, the largest measuring forty to fifty feet in length, though the average is considerably less than this. They are fairly robust in form and well covered with fat. They furnish no whalebone, but they produce from twenty to seventy barrels of oil, which, though not of the best quality, commands a good price in the market.

Solitary individuals of several other species of whales are frequently taken at the shore stations along this coast.

EDITORS' TABLE.

EDITORS: E. D. COPE AND J. S. KINGSLEY.

The bill lately introduced in the Senate by Senator Beck to provide for a National Zoological Park at Washington, "for the advancement of science and the instruction and recreation of the people," is certainly a step in the right direction, and one which might well have been taken long ago. As might be expected, the plan receives the unqualified endorsement and support of the Smithsonian Institution and National Museum, as indeed it must that of all scientists, friends of science, and the general public throughout the country.

The bill provides for an institution which shall be founded on a grand and liberal scale, and fully in keeping with the wealth, dignity and intelligence of the nation. The site is to be selected on Rock creek, just beyond the city limits, which would make the entrance to the grounds only a trifle over two miles from the Executive Mansion. The proposed site is one of great beauty, and even grandeur, for at two points high walls of rocks rise out of the picturesque valley to a height of over eighty feet.

The creek itself is a beautiful stream of very respectable proportions, describing a perfect letter S through the site to be chosen, and aside from its picturesque features it would afford unrivalled facilities for the care of aquatic mammals and birds of all kinds. Nearly the whole tract is covered by a fine growth of forest trees which, unless afforded immediate protection, is liable to be swept away by reckless real estate vandals.

It is proposed that the Zoological Park shall be established by three commissioners, the Secretary of the Smithsonian Institution, the Secretary of the Interior and the President of the District Board of Commissioners, and when fairly established it shall be turned over to the perpetual custody and care of the regents of Smithsonian. With the unrivalled facilities already enjoyed by the Institution through its multitude of correspondents and collectors, it would be possible to secure an immense number of valuable accessions by gift, and it is estimated that fully one-half of all the collections could be so obtained merely by paying the cost of transportation.

It is unnecessary to advance them any reasons why this bill should be passed, and the park established as proposed. We only allude to the great advantages to science and the general public which would inevitably result from the gathering together at the capital of the nation of a great collection of quadrupeds, birds, and reptiles living and breeding under highly favorable conditions. The time is fast approaching when many of our most noteworthy American quadrupeds will exist only in parks and menageries. The buffalo is now almost extinct in his wild state, and the Rocky Mountain goat is also certain to disappear in a very few years more.

Ours is almost the only great nation which does not maintain a national zoological garden on a grand scale, and we are glad to see that the idea of such an institution for us is at last taking tangible shape. It is eminently proper that it should be located at the capital city, which is now the scientific centre of the nation, and the Mecca which is visited annually by tens of thousands of citizens from every nook and corner of America.

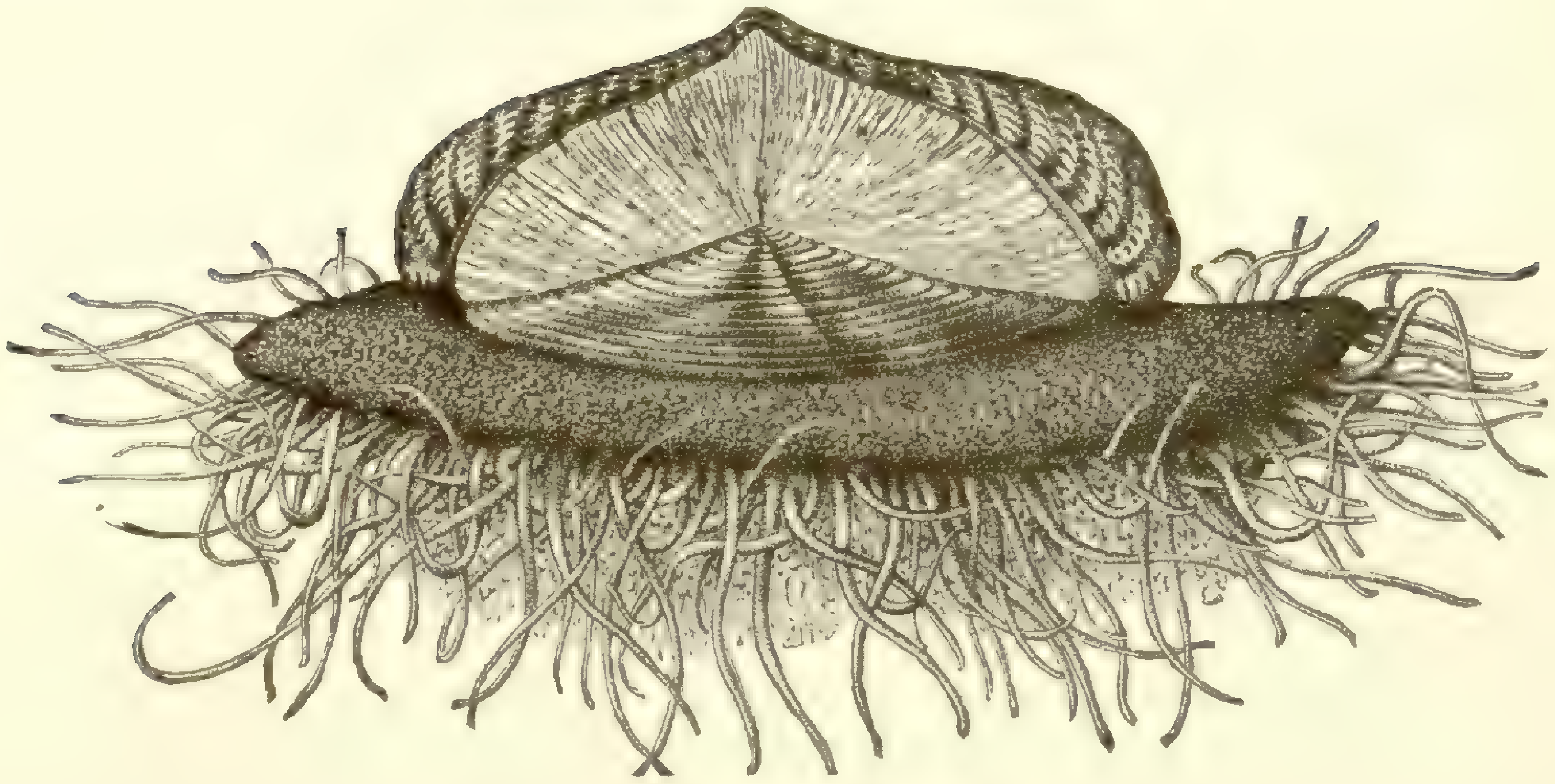
RECENT LITERATURE.

THREE CRUISES OF THE BLAKE.[1]—In recent years American work in marine exploration has been overshadowed by the prominence given to the celebrated Voyage of the "Challenger," while the magnificent manner in which the scientific results of that voyage have been published by Her Majesty's Government is unrivalled. Still, American science is doing much to unravel the secrets of the sea, and the investigations of the Fish Commission and of the Coast Survey stand second only to those of the "Challenger" in their importance.

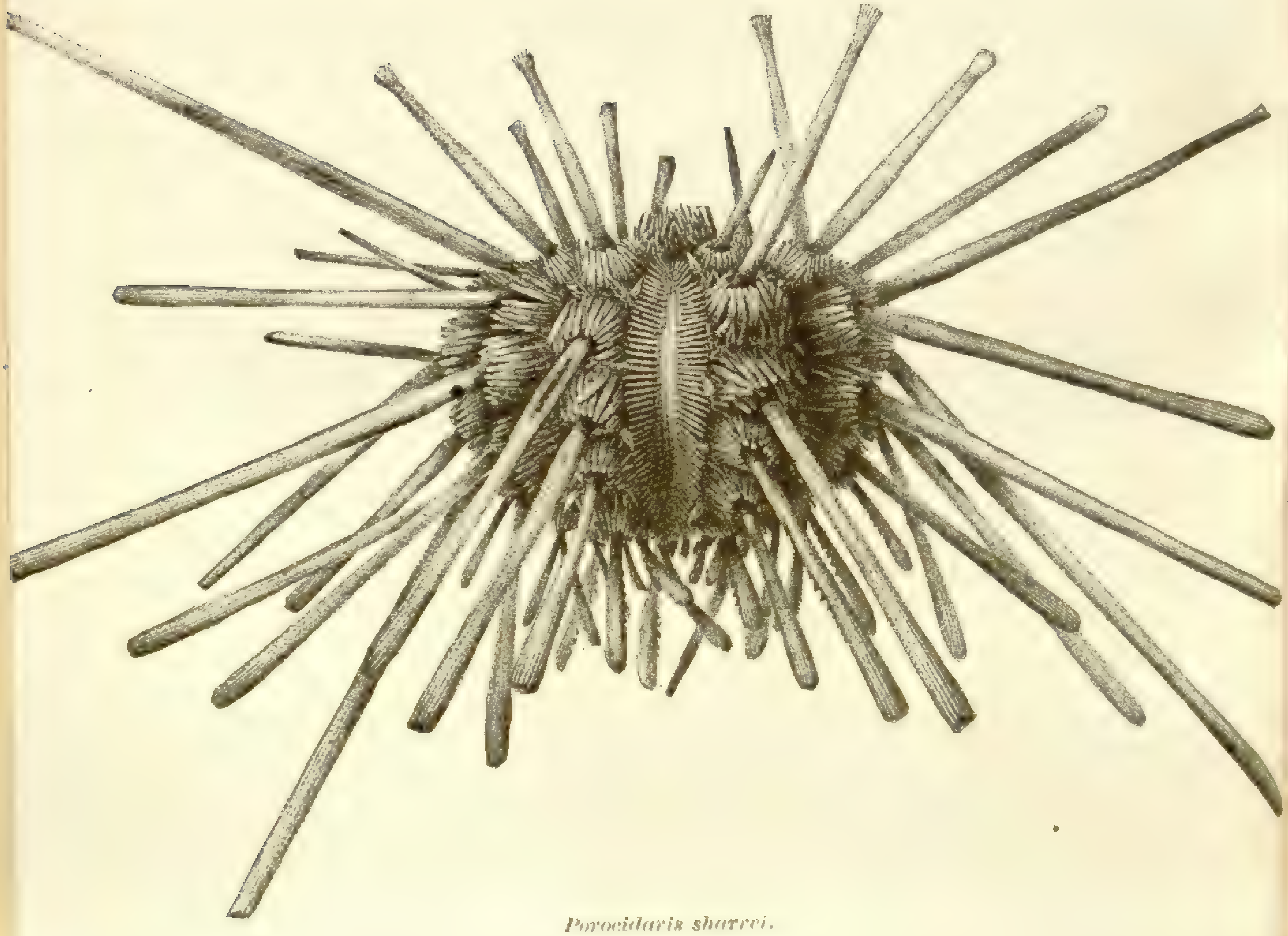
In the two volumes by Mr. Agassiz we have a popular account of the results of the Cruises of the Coast Survey Steamer "Blake," which is entitled to rank with the accounts of Moseley, Spry, or even of Wyville Thompson, of the Voyage of the "Challenger,"

[1] Three Cruises of the United States Coast and Geodetic Survey Steamer "Blake" in the Gulf of Mexico, in the Caribbean Sea and along the Atlantic Coast of the United States, from 1877 to 1880. By Alexander Agassiz. 2 vols. 8vo, pp. xxii., 314 and 220. Boston: Houghton, Mifflin & Co. 1888. $8.00.

PLATE VIII.

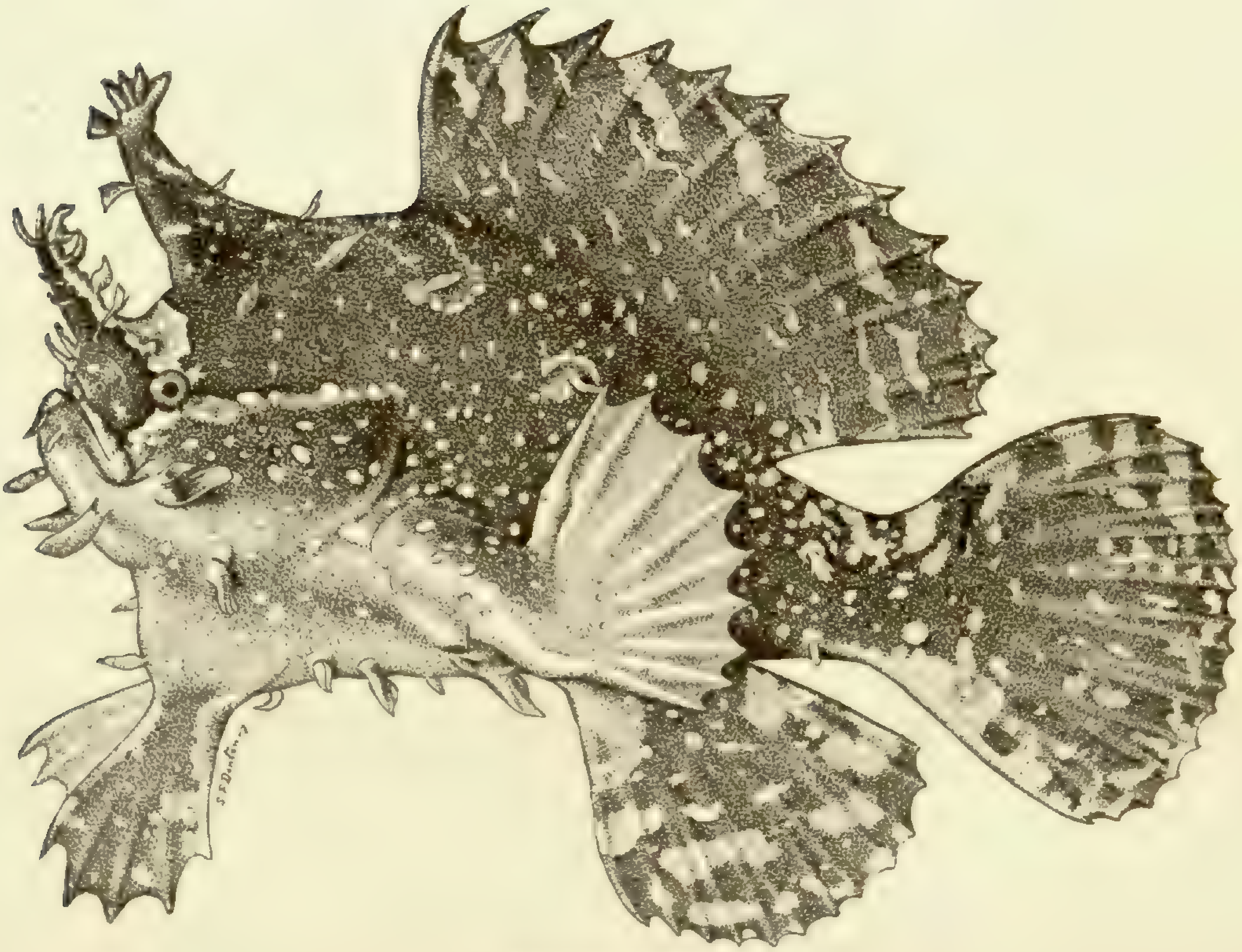


Velella mutica.

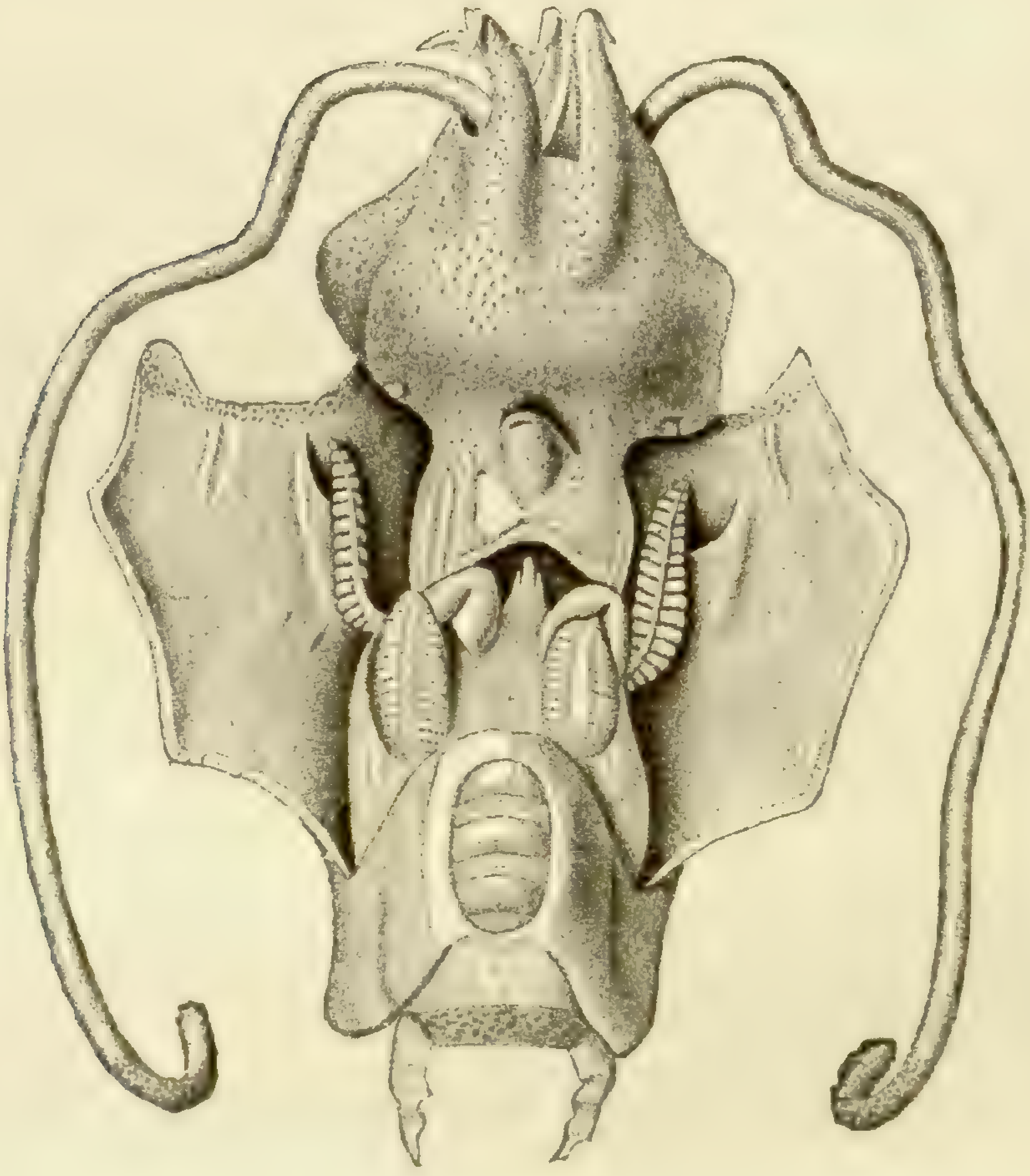


Porocidaris sharrei.

PLATE IX.



Antennarius.



Spirula.

while in wealth of illustration, in mechanical execution or in novelty of facts and theory, it stands second to none of these. Aside from the numerous maps, the illustrations have been mostly made by some of the photo-engraving processes, and the perfection to which these have arrived may be seen from the figures which accompany this notice.

Passing by the chapters which give a history of the progress of deep-sea investigation and that detailing the special equipment of the "Blake," a small three-hundred ton steamer,—for the work, we come to one which has a special fascination, since it deals with the structure of the Florida reefs and their bearings on the theories of coral reefs in general. Space will not allow a recapitulation of the structure of Florida and the Florida plateau, but the facts are such as to lead Dr. Agassiz to lean towards the theory of Semper rather than to that of Darwin and Dana in seeking their explanation.

Other chapters which have a bearing upon geology and physical geography are those upon the topography of the Eastern Coast of the North American continent; the permanence of continents and of oceanic basins; the temperature of the sea in the regions explored, not only at the surface, but at the bottom as well; and an account of the Gulf Stream. All of these are illustrated by charts and diagrams, some in color, and especially interesting among the maps are reproductions of some old ones in which the Gulf Stream is shown. Somewhat similar in character is the chapter dealing with sub-marine deposits, and especially those of the deep-sea where the sources of supply are so small that even the dust of shooting stars and meteorites form an appreciable element.

The chapter on the pelagic fauna is full of interest to anyone who has seen the prizes taken by the skimming net; but to most people the second volume, which deals exclusively with the animals of the deep-sea, will prove of greatest interest. Here the author has had the aid of specialists, and has brought together a compendious account of the strange and bizarre creatures inhabiting those depths. As some of the work has been in type for two years we miss, at times, references to late discussions of certain forms. Ipnops, for instance, that curious fish without eyes, but with peculiar sensory or phosphorescent organs occupying the whole upper surface of the head, is figured, but no reference is made to Moseley's recent investigation of its structure.

As a whole, the book is full of interest, not only to the naturalist, but to those who merely desire to keep posted on the latest discoveries and explorations. Typographical and other errors are extremely few, but one of the features which seems peculiar is the retention of the antiquated names Acalephs and Polyps.

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GENERAL NOTES.

GEOGRAPHY AND TRAVEL.[1]

AMERICA.—THE INTERIOR OF LABRADOR.—Mr. R. F. Holme recently read to the Royal Geographical Society an interesting account of a journey to the interior of Labrador. Although the coast is utterly bare and treeless, a luxurious forest growth commences at a distance inland of about twelve miles, and clothes the whole of the country except the barrens or moors, which are the home of the caribou. Mr. Holme has ascended all the rivers that flow into Hamilton Inlet as far as navigable in a boat. One of the most important of these is the Kenamou, used as one of the routes from the south. By far the largest river of this district is the Grand, which is the name given to the channel connecting Lake Petchikapou with Goose Bay, at the head of Hamilton Inlet. Grand River is really only a portion of a continuous water-way of rivers and lakes connecting Goose Bay with Ungava Bay. Lake Wiminikapou is situated about 150 miles from the mouth of Grand River, and thirty miles above that long and narrow lake are the Grand Falls, the height of which is not known, but which may prove to be among the most stupendous in the world. The elevation of the Labrador table-land is given by Professor Hind at 2240 feet, and at least 2000 feet of this are in the thirty miles between the head of these falls and the lake below.

Lake Petchikapou, one of the largest of the interior lakes of Eastern Labrador, is connected with the ocean not only by Grand River, but by Nascopee River and Grand Lake. The Indians of the interior of Labrador are all of the Cree nation, and are perhaps the most unadulterated Indians to be found on the continent. A. G. Guillemard, in a note to the May number of the Proc. Roy. Geog. Soc. suggests that possibly the Grand Falls of Grand River (Labrador) might be reached more readily by following up the Moisie River from the Gulf of St. Lawrence and skirting Lake Aswanipi. He also says: "The fall from a height at all approaching 2000 feet of a river 500 yards in width a short distance higher up, would form one of the wonders of the world, and would surely have been described by Mr. Maclean after returning from his visit in 1839. Mr. Guillemard mentions among waterfalls combining great volume of water and great height, the Garsoppa Falls in Western Hindostan, 300 yards wide and 830 feet high, and the Kaieteur Fall of the Potaro River in British Guiana, 123 yards wide and 741 feet in vertical height.

[1] Edited by W. N. Lockington, Philadelphia, Pa.

RAINFALL WEST OF THE MISSISSIPPI.—General A. W. Greely recently gave to the Washington Philosophical Society the partial results of the charting of recent observations on the rainfall west of the Mississippi. The number of observing stations has been doubled during the past ten years, and the result of the observations has been to greatly reduce the areas of small rainfall. The area in which less than fifteen inches per annum was supposed to fall has been diminished one quarter of a million of square miles since the census map of 1880. In some places where the precipitation was supposed to be five inches or less the actual rainfall is as much as sixteen inches and in one spot was found to be thirty-seven inches. General Greely explained that the small average of rainfall formerly reported in Southern California, was partly due to the fact that most of the observing stations were situated on the line of the Pacific Railroad which, seeking low gradients, had been built through a section of the country where the precipitation was small. General Greely, moreover, thinks that the prevalent opinion that the rainfall in the West is increasing, is correct.

ASIA.—THE PROVINCES OF KARS AND SEMIRECHINSK.—According to a report upon the province of Kars (until the last Turco-Russian war a portion of Asiatic Turkey) drawn up by Prince Masalsky, the Russian immigrants into that province are not in a prosperous condition. The motley population consists besides Russians, of Turks, Armenians, Yezidis, Kurds, Greeks, Turcomans and Circassians. The province of Semirechinsk (Turkistan) had a population of 758,258 in 1885. Of these 595,000 were Kirghis, the original inhabitants. Russian colonization is continually going on, but only the central portion of the district of Vernie is yet really Russian. Large numbers of Dungans and Taranchis have recently settled in this district.

THE MOGOK RUBY MINES, BURMA.—One of the finest sanitariums in India is that of Bernard-Myo, on the broad rolling plains of Enjouk, on the northern slopes of the hills bounding the ruby mining district of Mogok, Burma. Bernard-Myo is over 6000 feet above sea level. The ruby mining district may have a population of over 6000 people belonging to many different tribes. The mines are of three kinds: the working of fissure veins; washing in a somewhat similar manner to the hydraulic mining in California; and what may be called placer diggings. The third class of mines is at present the most important. At depths varying from ten to thirty feet, in the flatter lands of the valleys, there occurs a layer of corundum from a few inches to a few feet in thickness. When this corundum is brought to the surface myriads of small rubies glitter in the sun. Almost all the stones are water worn or of irregular shapes, and it is rarely that a flawless ruby is found. So rare is a ruby of the finest water that one of three carats is worth ten times

the value of a diamond the same size. The district of Mogok is situated between Mandalay and Bhamo and is nearer to the former place.

The Birds' Nest Islands.—The records of the Geological Survey of India (vol. xxi. pt. 1) have some information concerning the remarkable group of islands called by the Burman's Ye-ei-gnet thaik or Seabirds' Nests. These islands consist of six marble rocks to the southeast of Dumel Island at the southern extremity of Burma. The largest is a thousand feet high, about a mile in length, and of an oval shape. The great feature of the group are the birds nests caverns, which as a rule open into the sea. In other parts of the island are great caverns opening into circular basins, and Commander A. Carpenter, who writes the account, states his impression that these circular basins were at one time the floors of huge caverns, and that in past times the islands were far higher, with cavern over cavern.

Africa.—The Transvaal.—The configuration of the Transvaal Republic, according to Dr. A. Schank, is determined by mountain ranges; the Drakensberg range rises to a height of 7000 feet and traverses the country from North to South, presenting a steep declivity on the East and a gradually sloping table land on the West. The Eastern and smaller part of the Transvaal consists mainly of a series of low granite mountains. A series of parallel chains extend east and west through the country and divide it into a southern portion (the Hooge Veld) and a less elevated northern portion (the Bosch Veld). The former is connected with the plateau of the Drakensberg and enjoys one of the healthiest climates in the world.

Van Gèle's Ascent of the Mobangi.—The "Mouvement Géographique" of April 22, 1888, contains details of Lieutenant Van Gèle's recent ascent of the Mobangi. Van Gèle left Equator Station Oct. 27th, 1887, and on Nov. 21st reached the foot of the Zongo rapids, the spot at which the Rev. G. Grenfell was turned back in 1884. These rapids extend over a distance of twenty-four miles, and are six in number, but the steamer *En Avant* succeeded in passing them, though she had to be unloaded before she could pass the fifth, which consists of a group of islands connected together and with both banks by a rocky bar forming rapids and two falls. The banks of the river on both sides along the line of the rapids are bordered with gently sloping hills, studded with villages and presenting alternations of woods, meadows, maize fields and banana plantations. The villages on the river bank are palisaded in front and watch-posts are established in the cotton-trees. As far as Belly, in the middle of the cataracts the natives have their heads shaved except at the nape and wear fierce-looking moustaches. Above

Belly the Bakombe form the population and are distinguished from their neighbors by their method of wearing the hair, which extends behind in queues sometimes seven feet long. After passing the sixth rapid, at Mukuangai, the river comes from the northeast free from all obstacles and the view is described as superb. It has a width of about half a mile and an average depth of fourteen feet. After about twenty-two miles it bends eastward and continues in this direction as far as was navigated by Van Gèle (above 172 miles). Along this stretch the natives call it the Dua. The people on the right bank of this portion belong to the Buraka and Maduru tribes, those on the left to the Bakangi, Mombati, and Banzy. They shave the head so as to leave a little triangle of hair on the forehead, and wear immense copper rings or wooden cylinders in their ears. The native huts are cone-shaped, rest on a wall of stone about 2 feet high, and are neatly arranged in rows forming broad streets around a central building used as a common meeting place. These people work iron into all sorts of implements, weapons and ornaments. In this reach of river there are many islands, most of them inhabited and cultivated. A rapid was passed at about 130 miles above the Zongo rapids and twenty-five miles further east another was met with at which the steamer had to be unloaded. About twelve miles above this rapid (21° 30′ E. lon.) the Bangasso discharges into the right bank of the Mobangi. Up to this point the natives had invariably been friendly, offering for sale all kinds of provisions, but here difficulties began. The Mombongo and Takoma tribes which inhabit both banks were decidedly hostile, so, as the navigation was obstructed by rocks and sandbanks, Van Gèle decided to turn back at 21° 55′ east longitude. At this point the river is a mile and a half wide and is studded with islands, the larger of which are inhabited. As Dr. Junker coming westward reached 22° 55′ on the Welle, and as both points are in 4° 20′ N. lat., there can be little doubt of the identity of the Welle and Mobangi.

Geographical News.—Another voyage made by Dr. Schrader up the Empress Augusta River (New Guinea) confirms his previous opinion as to the important character of this waterway, which probably rises within the Dutch portion of the island, since the *Samoa* reached a spot distant but a few miles from the boundary line, and 380 miles from the mouth of the river. Not only the main river, but several of its affluents, are navigable for long distances during the rainy season.

M. Gamak, a Russian traveler, has recently explored the Khingan range, which divides Mongolia from Manchuria. He has crossed the range four times and has explored almost its whole length.

M. Kostenko gives the population of Russian Turkistan at 2,365,648, and that of non-Russian Turkistan at 3,042,000. Of

the latter 2,000,000 are in the Khanate of Bokhara, the remainder in Khiva and Afghan Turkistan.

The Proceedings of the Royal Geog. Soc., May 1888, contains a map of Mr. F. C. Selous' explorations in the Matabele and Mashuna countries, giving the routes of the various rivers and the position of the hill ranges with greater accuracy than any other previous map.

The death is announced of the celebrated Russian, Nicholas von Miklucho-Maclay, whose name has so long been prominent in connection with explorations in New Guinea. His residence in that country impaired his health, and in 1882 he returned to Russia. After this he resided awhile in Sydney (Australia) where he founded a biological station, and then again returned to Russia, where he resided at the time of his death, at the age of forty-two years.

GEOLOGY AND PALÆONTOLOGY.

Geological News.—Silurian, etc.—Dr. John Walther, in his researches into the structure of the crinoids (Palæontographica, Band 32), traces the entire group to a bilateral ancestral form, represented by the Pelmatozoa of the Pre-Cambrian, and considers the Ateleocystites of the Lower Silurian as a reversion to this ancestral and larval form. This is followed by an "acyclical" holosymmetrical form, exemplified by Macrocystella, the oldest Cambrian Pelmatozoan. From this form two series arise—on one hand, the Cystoids, on the other, the Crinoidea.

Devonian.—M. Maurice Gordon has discovered in the Valley of l'Arboust, in the Pyrenees, a schistose deposit with trilobites which are entirely new to the French fauna and ascend to an epoch that has recently been studied between the Hartz and the Ural. These trilobites include two new species of Bronteus and one each of Dalmanites, Lichas, Cyphaspis, and Harpes. M. Chas. Barrois states that the fauna is more recent than the Silurian stage of Bohemia and older than the Coblencian stage of the Devonian.

M. Chas. Barrois has identified twenty-eight species of crinoids, brachiopods, trilobites, etc., occurring in the singular sedimentary limestone of the quarry of Vallet, near Chaudefonds (France). Though this thin bed is certainly Devonian, it has not yet been correlated with the other Devonian bands of the region, but seems to form an islet in the midst of red and green schists, which are by some referred to the Lower Silurian, by others to the Upper Devonian, or even to the Carboniferous. The trilobites are Silurian, but the brachiopods and crinoids are Devonian, and the fossils, as a

whole, are referred by M. Barrois to the same horizon with the Eifelian beds of the Rhine.

The coral limestone of Cabrieres (Herault, France) is by M. Barrois ranged between the Eifelian and the Coblencian stages of the Devonian.

CARBONIFEROUS.—*Spirodomus insignis*, is a peculiar, spirally-twisted lamellibranch, recently described by Chas. E. Beecher, from the attenuated Waverly series of northwestern Pennsylvania. In its reflexed and minutely plicated margins and absence of proper hinge, this shell suggests some forms of Pholas, and its spiral form seems to indicate a burrowing habit.

Among the impressions of fishes collected in the shales of the coal-beds of Commentry are some with a cartilaginous skeleton ossified at certain points and presenting peculiarities not to be found in any other living or extinct fish. The study of twenty-three examples of this fish, some of them in a good state of preservation, has enabled M. Brongniart to describe it under the name of *Pleuracanthus gaudryi*. In form this fish resembles a shark, and in length it varies from eighteen to forty inches.

JURASSIC.—Dr. E. Fraas (Palæontographica, Band 32) treats of the asteriads of the White Jura of Swabia and Franconia, with researches into the structure of echinoderms and the skeleton of the Asteroidea. He describes as new *Astropecten infirmum* and *A. elegans;* also *Pentacerus pustuliferus*, from the lithographic schists of Kelheim.

E. Koken (Palæont. Abhandl., 1887) has contributed additional information upon the Dinosauria, Crocodilia, and Sauropterygia of the Wealden of Northern Germany. Among the crocodiles, *Goniopholis pugnax* and *G. minor*, and among the Sauropterygia, *Plesiosaurus degenhardti*, *Pl. limnophilus*, and a third unnamed Plesiosaurus, are new. The work also contains much information upon the development of the brain and auditory passages of the genus Macrorhynchus.

CRETACEOUS.—*Gigantichthys pharao* is the name given to a fossil fish of the family Trichiuridæ, collected by Professor Schweinfurth in the cretaceous beds of Egypt, within ten kilometres of the Pyramids of Gizeh.

CÆNOZOIC.—Dr. O. Roger concludes (Ueber *Dinotherium bavaricum*, Palæontographica, Band 32) that *D. bavaricum* is the smaller, older ancestral form, contemporary with Anchitherium, out of which, by a series of transitional forms, the gigantic *Din. giganteum* was finally developed in the Hipparion period.

In 1885 Professor M. Neumayr and Dr. L. v. Tausch undertook explorations in the Pliocene beds of Pikermi, near Athens, for the

benefit of the Vienna Museum, and the result of their work has been to considerably widen our knowledge of that rich fauna. Dr. A. Weithofer describes as new *Mustela palæattica*, *Machairodus schlosseri*, *Camelopardalis parva*, *Helicoceras rotundicorne*, and *Varanus marathonensis*, and mentions some avian remains of as yet undetermined forms, two of which seem to belong to the genus Gallus. A species of Felis, mentioned but not described by Gaudry in 1862 as at least equal in size to the largest jaguar, is by Dr. Weithofer described as *F. leiodon*. *Helicoceras rotundicorne* is a gazelle-like antelope with rather large and spiral horns.

A. S. Woodward (*Geol. Mag.*, July, 1887) describes *Arius egertoni* and *A.* (?) *bartonensis*, two forms of siluroids from the Middle and Upper Eocene beds of Bracklesham and Barton (England).

Van Beneden (*Zeitschr. deutsch. geol., Ges.* 1887) has described Cetacean remains from the northern slopes of the Caucasus. These remains probably belong to the genera Squalodon and Cetotherium. The age is Upper Miocene.

PLEISTOCENE.—The exploration of the caves in the Karnul district of Madras, conducted by Mr. R. B. Foote, has resulted in the finding of about forty species of Mammalia, of which Mr. R. Lydekker (Mem. Geol. Surv., India, Ser. X., Vol. IV., Pt. 2) describes as new *Viverra karnuliensis*, *Hystrix crassidens*, *Atherura karnuliensis*, *Rhinoceros karnuliensis*, and *Sus karnuliensis*. The most important of the Karnul caves are those of Billa Surgam, which consist of three short and deep cañons joined by natural arches, and with caves opening into them at various levels. The comparatively large number of extinct forms and forms not now to be found in India that occur in these deposits renders it probable that they are not newer than the Pleistocene, and Mr. Lydekker refers them to the later part of the Narbada period. The most remarkable features of the list are the occurrence of a Cynocephalus which may be identical with a living African species; of *Hyæna crocuta;* of a small Equus indistinguishable from *E. asinus*, and of a Manis, apparently identical with the existing West African *M. gigantea;* while the occurrence of a peculiar species of Rhinoceros and of a Hystrix and a Viverra specifically distinct from those now living in India, as well as of the non-Indian genus Atherura, is scarcely less noteworthy. The evidence afforded by this cave-fauna strengthens that afforded by the Siwaliks as to the probable derivation of many of the existing Ethiopian mammals from those of the later tertiaries of India.

Drs. L. Doderlein and E. Schumacher describe, in a bulletin of the Geological Survey of Alsace-Lorraine, a rich diluvial mammalian fauna that has been recently found at Voklinshofen, near Colmar. Twenty-nine forms are listed, most of them large and mostly extinct in Alsace, though many occur in northern Europe or in the Alps.

MINERALOGY AND PETROGRAPHY.[1]

PETROGRAPHICAL NEWS.—In a preliminary notice of the rocks occurring in the neighborhood of Ilchester, Howard county, Md., Mr. Hobbs[2] describes some interesting features of the eruptive masses of the region. The oldest rock within the area studied is a hypersthene-gabbro with its associated alteration products.[3] In the gabbro diorite, originating by dynamic metamorphism from the massive hypersthene-gabbro, ilmenite and rutile are found to be so associated with sphene as to lead the author to regard the rutile as an intermediate product in the alteration of ilmenite to sphene. The end product in the alteration of the gabbro is a typical hornblende-gneiss, in which peripheral granulation of the original feldspar can be detected. A quartz-mica-diorite, in which the quartz is in porphyritic crystals, contains about equal proportions of orthoclase and plagioclase. The most common form of granite, cutting the gabbros and allied rocks, is a coarse pegmatite in which microcline crystals a foot in diameter are sometimes observed. A less common form of granite is a gneissic granite-porphyry, most interesting on account of the occurrence in it of the rare mineral allanite,[4] in parallel intergrowths with epidote.—The diabase pitchstone of Sordaval, in Finland, was for a long time regarded as a mineral, to which the name sordawalite was given. This substance has lately been very carefully studied by Lœwinson-Lessing,[5] who finds it occurring as a dyke, cutting amphibole-schists. In the centre of the dyke the material is highly crystalline; at its edges it is very vitreous. Several types of the vitreous variety are characterized, as hyaline, globulitic, spherulitic and microlitic. The first-mentioned variety gives rise by alteration to several sub-varieties, among which may be mentioned the granellitic and radiolitic varieties. The former consists of a glassy type, in which certain dark particles group themselves so as to produce patches of a dark color on a background of light-colored glass, without the production of a true globulitic or spherulitic structure. In the radiolitic variety devitrification products are divergently arranged around a centre.—The nodules of the coarse granite at Ghistorrai, Sardinia, are described by Fouqué[6] as composed of a centre of orthoclase, oligoclase, biotite and muscovite, around which is a zone consisting of triclinic soda-feldspar and biotite, arranged in concentric layers. The biotite of the nodule is older than the feldspar and remains quite fresh, while the same mineral in the body of the rock is much altered.

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.
[2] Johns Hopkins Univ. Circ., No. 65, April, 1888, p. 68.
[3] Cf. Amer. Naturalist, 1886, p. 1049.
[4] Cf. Amer. Naturalist.
[5] Min. u. Petrog. Mitth., 1887, ix., p. 61.
[6] Bull. d. l. Soc. Franç d. Min., x., p. 57.

New Minerals.—*Caracolite* from Caracoles, Chili, has lately been described by Sandberger[1] as a new mineral. It is intimately associated with percylite, and like this latter is regarded as derived from galena by alteration. Caracolite occurs in transparent crystals with a hexagonal habit; produced by trillings of rhombic individuals according to the aragonite law. The axial ratio is: $a : b : c = .5843 : 1 : .4213$. Its specific gravity is 5.1. Its analysis yielded results corresponding to the formula Pb (OH) Cl + Na_2 SO_4. The associated *percylite* was also analyzed and found to correspond to Pb (OH) Cl + Cu (OH) Cl.—*Mursinskite*[2] has been found only in two small yellow translucent crystals at the topaz locality at Mursinsk, near Alabaschka, in the province of Ekaterinoslaw, Russia. The crystals are tetragonal with an axial ratio, $a : c = 1 : 0.5664$. They are bounded by P, 2P ∞, $\frac{5}{3}$ P ∞, and various ditetragonal pyramids. Their composition is unknown. —*Bementite* is a radially fibrous mineral not unlike pyrophyllite in appearance, which occurs at Franklin, N. J. Its color is grayish yellow, and its specific gravity 2.981. Its composition as described by Prof. König[3] is:—

SiO_2	MnO	FeO	ZnO	MgO	H_2O
39.00	42.12	3.75	2.86	3.83	8.44.

corresponding very nearly to $(H_2\ Mn)_2\ Si\ O_4$.—*Martinite* is a new calcium phosphate from the Island Curaçoa, in the West Indies. It occurs, according to Kloos,[4] only in pseudomorphs after gypsum. Under the microscope it is seen to consist of an aggregate of little rhombohedra. Its specific gravity is 2.892 to 2.896. Its analysis yielded:—

P_2O_5	CaO	H_2O	Org. subs.	Insol.
47.77	47.20	4.52	.75	.20

—*Arseniopleite* is a reddish brown substance associated with rhodonite and hausmannite in veins in a crystalline limestone at the Sjö mine, Gryhyttan, Province of Oerebro, Sweden. Its analysis yielded Igelström[5]:—

As_2O_5	MnO	Fe_2O_3	PbO	CaO	MgO	H_2O
44.98	28.25	3.68	4.48	8.11	3.10	5.67

—*Barysilite*[6] is a lead silicate (3Pb O. 2Si O_2) from the Harstig iron mine at Pajsberg, Sweden. Its color is white, crystallization hexagonal, hardness about 3, and its specific gravity 6.11 to 6.55.—*Calciothorite*, *Melanocerite* and *Rosenbuschite* are silicates of the rare

[1] Neues Jahrb. f. Min., etc., 1887, ii., p. 75, and Websky: Sitzb. Ak. Wissensch Berlin, Nov., 1886.

[2] Kokscharow: Bull. d. l'Acad. Imp. des Sciences d. St. Petersb., 1887, p. 450.

[3] Proc. Acad. Nat. Sc. Phila., Oct., 1887, p. 311.

[4] Sammlg. d. Geol. Reichsmus. Leiden. Ser. ii., Bd. i. Ref. Neues Jahrb. f. Min., etc., 1888, i., p. 41.

[5] Bull. Soc. Min., 1888, xi., p. 39.

[6] Sjögren and Lundström: Oefv. Vet. Ak. Förh., 1888, xlv., p. 7.

metals. They are found in the elæolite-syenite veins of Norway.[1] —*Cliftonite.* With reference to certain little cubical crystals of graphite (?) found in pieces of an iron meteorite from Youndequi, Australia, Fletcher[2] states that Haidinger as early as 1846 described crystals of graphite, which he regarded as pseudomorphs after pyrite. Since pyrite does not occur in meteorites, and since, moreover, these little graphite pieces are entirely surrounded by metallic iron, Fletcher thinks that their shape must be original, and that this substance is truly regular in crystallization.

Crystallographic News.—It has been known for a long time past that the natural conclusions to be drawn from the Bravais-Mallard theory of cleavage planes and crystal structure, based upon the point system of explaining crystallization, have not been borne out by the facts. As a consequence of this theory it is demanded that the planes of easiest cleavage in a mineral should be parallel to those planes which are most commonly present on it and best developed. This is known, however, not to be the case. Sohncke[3] explains how these difficulties can be met by modifying the theory of the point system, as pointed out by him in recent[4] papers.—The same subject is further discussed by Wulff,[5] who takes up the different crystallographic systems in detail, describes in terms of the theory the inner structure of minerals crystallizing in each, and pictures the development of holohedral, hemihedral and hemimorphic forms. Three lithographic tables, with one hundred figures, illustrate the paper.—Brugnatelli[6] has subjected the *elatholite* occurring in the contact between serpentine and gabbro at the Serra dei Zanchetti, in the Bolognese Appenines in Italy, to a complete examination, both crystallographic and optical. He finds forty-one forms on the crystals examined, among them the new forms $\frac{4}{3}\bar{P}\overline{\infty}$, $2\bar{P}2$, $-5\bar{P}5$, $-\frac{3}{2}\bar{P}3$, $-\frac{5}{2}\bar{P}5$ and $3\bar{P}\frac{3}{2}$ ($a:b:c = 1.2657:1:.6354$ $\beta = 89° 51'$). The optical angled measured in oil is $74° 21'$ for sodium light, and the first bisectrix is inclined $51'$ to the c axis, in the acute angle β. An analysis of the mineral gave $SiO_2 = 37.89$, $CaO = 35.04$, $B_2O_3 = 21.23$, $H_2O = 5.84$.—*Cinnabar* crystals from Mt. Avala, near Belgrade in Servia, have been carefully measured by A. Schmidt.[7] He finds on them trapezohedral forms so largely developed as to determine their habit. To the forty-eight forms already described as occurring on the mineral, Schmidt adds ten new ones, viz.: $\frac{1}{2}P2$, $\frac{2}{3}P2$, $\frac{6}{13}P\frac{6}{5}$, $\frac{2}{5}P\frac{4}{3}$, $2P\frac{4}{3}$, $2P\frac{5}{4}$, $\frac{3}{7}P\frac{3}{2}$, $\frac{8}{5}P\frac{8}{5}$, $\frac{10}{23}P\frac{5}{3}$ and $\frac{5}{6}P\frac{5}{3}$.—The negative deltoid dodecahedron $-\frac{3O}{2}$

[1] Brögger: Geol. Fören. Föhr., 1887, ix., p. 247.
[2] Miner. Magazine, July, 1887; and Zeits. f. Kryst., xiii., 1887, p. 383.
[3] Zeitsc. f. Kryst., xiii., 1887, p. 209.
[4] Wiedem. Annalen, 1882, 16, p. 499.
[5] Zeits. f. Kryst., xiii., 1888, p. 503.
[6] Zeits. f. Kryst., xiii., 1887, p. 150.
[7] Zeits. f. Kryst., xiii., 1888, p. 433.

has been detected by Hintze[1] on a crystal of sphalerite from Striegau.

Miscellaneous.—As the result of a series of experiments upon the strongly pleochroic epidote of Sulzbachthal, Ramsay[2] finds that the absorption colors of this mineral are not symmetrically arranged around the axes of elasticity *a* and *c* lying in the plane of symmetry. Moreover, he finds that the absorption axes—the directions in which the greatest, the least and the mean absorption takes place—do not correspond with the axes of greatest, least and mean elasticity, as had already been indicated by earlier observations. The direction of greatest absorption for the red ray in the clinopinacoid is inclined 28° to the axis of least elasticity, while the direction of absorption of the green ray is inclined 35°. After examining a large number of thin plates prepared from epidote and other monoclinic minerals, and one triclinic mineral, Ramsay concludes (1) that one of the absorption axes in monoclinic crystals coincides with the axis of symmetry *b*, while the other two lying in the plane of symmetry do not necessarily coincide with the axes of elasticity for the same color. In triclinic minerals there is no accordance between the absorption axes and the axes of elasticity. (2) The axes of greatest and of least absorption for any given color in triclinic minerals and the absorption axes lying in the plane of symmetry of monoclinic minerals are not always perpendicular to each other, as are the axes of elasticity.—The same subject is discussed mathematically by Drude,[3] who calculates the positions of absorption maxima in monoclinic and triclinic minerals from data obtained by Ramsay. He finds slight discordances between the observations of Ramsay and the theoretical demands, but concludes that, on the whole, Voight's[4] theory of absorption is substantiated.—By supplying a blast lamp with warm air and with oxygen, Specia[5] has succeeded in fusing many of the minerals infusible under ordinary conditions. The differences in their conduct under these changed conditions may serve to distinguish between minerals having the same general appearance; *e.g.*, quartz is infusible even when the blast lamp is supplied with warm air, while it is easily fusible to a colorless glass when oxygen is used. Colorless topaz is difficultly fusible in the first case, while it fuses readily with intumescence in the second case. Colorless zircon is infusible in both cases, but becomes cloudy at the high temperature produced by the combustion with oxygen.

[1] Zeits. f. Kryst., xiii., 1887, p. 161.
[2] Zeits. f. Krystallographie, 1887, xiii., p. 98.
[3] Zeits. f. Krystallographie, 1888, xiii., p. 567.
[4] Wiedem. Annalen., 1884, 23, p. 577.
[5] Atti. d. R. Accad. d. Scienze di Torino, xxii., p. 1887. Ref. N. J. B., 1888, i., p. 177.

BOTANY.[1]

AN OVERLOOKED FUNCTION OF MANY FRUITS.—It is a matter of common observation that many fruits (carpels) are green in color for a considerable period after the fertilization of the ovules, but I am not aware that particular attention has been called to the significance of this fact. Different botanical authors mention, incidentally as it were, the fact that as long as the young fruits are green they, of course, perform the functions of leaves, by the fixation of carbon in the process of assimilation. All such statements, however, take no account of the fact that young fruits, for the most part, are not green at first, but become so during their increase in size; in other words, the *greening* of the young fruit has been overlooked as having any significance. It has apparently been assumed that young fruits must turn green as a matter of course.

I wish to suggest that the very general development of chlorophyll-bearing tissue is for the nutrition of the embryo in the seed. The White Elm (*Ulmus americana* L.) affords a good illustration of this function of the fruit. At the time of flowering there are no leaves upon the tree, nor do any appear until the fruits are full grown, yet within a few days after the fertilization of the ovules, the growing fruits cover the tree with a green coat resembling that afforded by the leaves themselves a few weeks later. The first assimilation by this tree in the spring is done by the chlorophyll-bearing tissue of the young fruits. The same holds true for the Red Elm (*Ulmus fulva* Mich.).

The Box Elder (*Negundo aceroides* Moench) develops its fruits much later, but they take on likewise a rich green color, and in the latter part of May in some instances add fully fifty per cent. to the assimilating surface of the tree. Maples, Ashes, and even Poplars and Willows, the latter to a less degree, present the same phenomena, and in fact, in by far the greater number of instances the greening of the fruit for aid in the work of assimilation is the rule.

In the Pines and their allies the development of chlorophyll-bearing tissue is confined to the scales of the cone. In the biennial species there is but little green tissue the first year, when the ovule is dormant, but with the beginning of those rapid changes which occur in the spring of the second year, the scales become enlarged into great masses of parenchyma richly provided with chlorophyll. So marked is this that I have often wondered whether the scale was not primarily developed as an organ of nutrition. I have thought, sometimes, that possibly the scale was but a kind of dorsal growth of the ovule, in order to provide itself with an assimilating tissue. —*Charles E. Bessey.*

[1] **Edited by Prof. Chas. E. Bessey, Lincoln, Neb.**

A Depauperate Grass.—The accompanying illustrations (Figs. 1 and 2) show a depauperate individual of *Sporobolus vaginæflorus*, found entangled in the roots of a *Solidago* which was collected on the high prairie a few miles southwest of Lincoln. This little grass had three flowers, two of which had ripened seeds. The lower one of the three was still included in the upper leaf sheath.

1

Fig. 1.—Plant of *Sporobolus vaginæflorus* Torr., natural size.

2

Fig. 2.—A spikelet dissected, magnified ten diameters.

The sod from which the specimen was taken was formed of *Stipa spartea, Andropogon provincialis, A. scoparius* and *Bouteloua racemosa*, and a close observer would find no trace of the Sporobolus. In fact, *S. vaginæflorus* does not appear on the uplands except where the ground has been broken by natural or artificial agencies. The presence of this single specimen clinging to the roots of a high prairie denizen is of great significance in explaining its apparently sudden appearance on gopher mounds and along cultivated fields.

The existence of depauperate plants stowed away down out of sight, struggling hard with the powerful and strong for a scanty subsistence, waiting for better conditions and better times, doubtless bears a more important relation than has been thought to the sudden appearance of strange plants.—*Jared G. Smith, Lincoln, Neb.*

Botanical News.—The "Preliminary Catalogue of Anthophyta and Pteridophyta reported as growing spontaneously within one hundred miles of New York City," compiled by a committee of the Torrey Botanical Club, is a valuable addition to catalogue literature. It is important also on account of the adoption by the club of the term Anthophyta for the Flowering plants.—The Proceedings of the Forestry Convention, held in Grand Rapids, Michigan, January 26 and 27, 1888, has been published in a pamphlet of sixty pages, and contains along with much indifferent matter some which has value.—In marked contrast with the foregoing in the treatment of the subject are the "Lectures on Forests and Forest Products," given by Dr. G. L. Goodale before the Lowell Institute, in February and March of 1888. The Syllabus of the lectures shows a thoroughly scientific treatment of the subject. Perhaps the two methods of handling the subject are necessary, but for our part we greatly prefer that of the Harvard

professor.—Dr. N. L. Britton has described and figured the remains of a supposed plant from the white crystalline limestone (Archaean) of Sussex Co., New Jersey. He names it *Archæophyton newberryanum*, and gives a good plate. The paper appeared in the Annals of the New York Academy of Sciences, Vol. IV., No. 4. —The microscopical anatomy of the common cedar apple (*Gymnosporangium macropus*) has been investigated by Elmer Sanford (in the Botanical Laboratory of the University of Michigan), the results of which appeared as a paper in the February number of the *Annals of Botany*.—Dr. Farlow has added to his list of works on North American Fungi by the publication of nearly one hundred additional titles, in No. 30 of the Bulletins of Harvard University Library.—In Professor Trelease's study of the North American Geraniaceæ (Memoirs Boston Society Nat. Hist., Vol. IV.) the author has brought together descriptions of our species of the order, with biological notes, references to their pollination, dissemination, etc. Four good plates aid in giving to the monograph greater value.

ZOOLOGY.

North American Infusoria.—Dr. A. C. Stokes has done students of the Infusoria good service in collecting together in his "Preliminary Contribution toward a History of the Fresh-water Infusoria of the United States" (*Journal Trenton Nat. Hist. Soc.*, vol. i., pp. 71–344, pls. xiii., 1888), an extended catalogue of all the known species in the United States. Even his own papers appeared in so many places that it was rapidly becoming impossible to keep track of them all. In the present catalogue 351 species are enumerated, distributed as follows:—

Flagellata		153
Monadina	27	
Euglenoidea	46	
Heteromastigoida	20	
Isomastigoida	24	
Choano-flagellata	30	
Dino-flagellata	3	
Cilio-flagellata	3	
Ciliata		268
Holotricha	58	
Heterotricha	29	
Peritricha	122	
Hypotricha	59	
Suctoria		30

It will be noticed that Dr. Stokes accepts both the Cilio- and the Dino-flagellata, contrary to the recent classifications. His reasons

are that while there is a second flagellum in some of the Peridinidæ, in others of the old group of Cilio-flagellates there are true cilia in the equatorial grove or scattered over the surface of the body, and hence the group must be retained. It is interesting to note that while Dr. Stokes has given names to nearly 250 new species of Infusoria in his various papers, he has carefully refrained from adding to the number in the present contribution.

Two Cases of Symbiosis.—Dr. C. P. Sluiter notices two instances of "mutualismus" as occurring in the seas of Batavia. In shallow water there is found a large sea anemone (Actinia) abundant on the dead coral. It spreads a disc sometimes sixteen inches across, the disc, tentacles and body being colored of various shades of purple. Swimming in and out among the tentacles of this actinia are usually found two or more small species of fish identified as *Trachichthys tunicatus*. These seem to suffer not the least harm from the cœlenterate nettle cells, but rather to seek protection from enemies among the tentacles. In one case, Dr. Sluiter removed several fish from their protector and placed them in an aquarium with several larger fishes. The little ones tried their best to hide among the corals and the spines of the echinoderms, but soon fell victims to the appetites of their cousins. Others placed under similar conditions, but in company with anemones, survived for over half a year. They prove very timid, and rarely venture but a short distance from home. Their food is mostly the droppings from the Actinians table.

The second case, also noticed by Sluiter, occurs between Bunodes and *Trachichthys clarkii*. In this instance but a single fish has been found with each anemone, but this, as it is larger than its relative, ventures farther from home in search of food. In case a bit of food be dropped near the Bunodes, the fish darts out and, when it is about eight inches away, seizes the morsel, which may be half as large as itself, and quickly darts back to the hiding-place. Then the fish jerks the meat against the tentacles, and when these have grasped it, the fish tears it in shreds, some of which are small enough to be swallowed. In case the actinian has swallowed the morsel before the fish has had its fill, the latter darts into the stomach and brings out the matter, and proceeds to tear it to pieces as before.

Earth-Worms.—N. Kulagin communicates (*Zool. Anzeiger* xi., 231) some observations on Russian Earth-worms which are worthy of note. The cuticle, composed of H, C, O and N, is not a true chitin, but might be called a precourser of it. It dissolves readily in weak hydrochloric and other acids, and to prevent this effect by the humus acids in which the worm lives, the ectodermal glands secrete an alkaline fluid. The egg cocoons differ much, as they withstand strong acids and pepsin. The fluid of the mouth and

pharynx has an alkaline reaction, and converts starch into sugar and fibrin into peptone. The calc-glands also alter starch. The gastric juice is much like pancreatic juice, but is distinguished by the presence of tripsin, and by the fact that it apparently works better in the presence of weak acids. The cells of the typhlosole not only absorb the digestive juices, but they also have a digestive function much like that of the pancreas of the Vertebrates. Other observations relate to the histology of the epidermis, the pigment material, the œsophageal muscles and the calc glands. Some notes are made on the distribution of the Russian species, two of which occur even in the Lena Delta.

RECENT NOTES ON SCAPHIOPUS HOLBROOKII.—The general characteristics of this animal have been long and familiarly known and its more prominent anatomical features clearly defined; but its rather circumscribed distribution and comparative rarety, even where known to exist, have made somewhat difficult any extensive study of its peculiar nature and habits.

A summer on Martha's Vineyard, and the occasion of a sudden and tremendous rainfall, afforded an opportunity for certain very interesting observations.

If the literature of the subject is any indication as to its familiarity, the submission of the following notes may not seem a work of supererrogation; for, aside from the studies of Dr. Chas. C. Abbott, published in Vol. XVIII, No. 11, of the AM. NATURALIST, and those of Colonel Nicolas Pike, published in Vol. I, No. 7, of the *Bulletin of the American Museum of Natural History*, I have not been able to find anything except brief notes, scattered in miscellaneous works, though I believe notes on its occurrence have been made by Mr. Nichols and by Mr. Fred. S. Smith.

My observations, as will be seen, add but little that is *new;* yet a record of them may contribute somewhat to corroborate and extend that which does exist.

One afternoon, about August 10, 1887, while at work in the laboratory of the Martha's Vineyard Summer Institute, in company with Dr. H. W. Conn, Professor L. W. Chaney, and others, a very sudden and torrential rainstorm occurred, lasting some two hours or more. During an interval of cessation our attention was diverted by weird, plaintive sort of cries, which none at first was able to explain. Darting out through the still-falling rain toward a low sort of hollow, from which the cries seemed to come, it was found to have been converted into quite a pond, though previously quite dry. In this, and swimming about in a state of the greatest activity and excitement, were what looked to be scores of toads. No difficulty was found in securing a few specimens, which were at once identified as "spadefoots." Procuring a scoop-net, we took several dozens of them, leaving many more in the pond.

This was about four o'clock in the afternoon, and they continued

their orgies till late at night. But I made careful examination the following morning, without finding a single specimen—not even a sign of one. In the water I found plenty of the spawn attached to grass and floating in strings, loosely attached to weeds—a fact which clearly indicated the purpose of their presence and peculiar excitement.

On account of the pressure of other studies, I was not able to watch the development of the eggs. Indeed, I doubt whether they ever hatched, as the pond was nearly dry before the close of the following day, and the soil, being of the loose sandy drift peculiar to that locality, would not certainly retain water for sufficient time for the growth of the tadpole—if, indeed, for the hatching of the eggs, though, as to this last, I cannot say, as I left before it could have occurred.

This characteristic of the spawning habit is certainly peculiar, and seems somewhat difficult to explain. First, the lateness of the season is remarkable. It is said that a related European species breeds twice a year. Can it be possible that such is the case with Scaphiopus? There are some facts which seem to indicate that it might be, though it is hardly probable. Second, the places of spawning is still more remarkable. From the observations of Dr. Abbott and Colonel Pike, as well as my own, the choice seems to be for some temporary sink-hole or surface-pond. If the conditions for development in these places from speedy drainage, etc., were not so utterly precarious, it might be thought a shrewd precaution for evading the natural enemies common in the more permanent ponds and bogs. Altogether, the case seems to be quite anomalous.

But to refer again to the adults in the pond: There they were by scores. Whence had they come, and in such numbers? In all probabilities, from the ground of the bordering hillsides and environs. But not a single specimen was seen out of the water, and that, too, notwithstanding we were at the pond almost immediately following their first coming. If they had come from any tolerable distance, it would seem that some late-comers would have been detected. Again, their retreat must have been almost as sudden as their appearance. I passed the pond about ten o'clock at night, and the air was perfectly vocal with their never-to-be-forgotten notes. I went to the pond early the following morning, but all was silent and deserted. Had they returned to the ground? Such seems the most probable explanation. Yet so carefully had they covered the retreat that not the slightest trace could be found.

Furthermore, their appearance itself seems to be capricious and phenomenal. I made inquiries of persons of observant habits as to any previous occurrence in the vicinity, but was not able to find any account of them.

It has been suggested that they are, doubtless, nocturnal in habit, and that this explains, in a measure, their comparative rarity, even where known to exist. I have no hesitancy in assenting to the

nocturnal habit. It is quite in keeping with the habit of many of the order; and the vertical pupil of the eye points likewise to the same fact. This, however, in itself, must be a comparatively small factor in the case, and, alone, would hardly insure it against frequent detection any more than does a similar habit in many other nocturnal animals. I had gone by this hollow repeatedly, night after night, both before and after this appearance, and, though constantly on the alert to notice anything of the sort, had no hint of their presence.

Doubtless, the solitary burrowing habit goes much further in explaining its seclusion. But even this would be inadequate, unless the animal persistently avoided all open and cultivated grounds. Such, only, would protect it against frequent exposure by the spade or plow.

Altogether, they are certainly the most peculiar and erratic of any of the order; and, under the peculiar difficulties in the way of continuous study, it will be long ere its life-history can be said to be thoroughly known. However, the very difficulties add a charm to the investigation, which we may hope will lead to success. To me, the brief research herein outlined has been full of the liveliest interest, and, while but a mite toward the solution of the problem, I shall hope that it may not be without some value when a final summary is made.—*C. W. Hargitt, Moore's Hill, Ind.*

THE RELATIVE WEIGHT OF THE BRAIN TO THE BODY IN BIRDS. — In a former number of the AMERICAN NATURALIST,[1] notice was made of the relative weight of the brain to the body in *Spizella socialis*, and *Regulus satrapa* compared to that of man. Since that time more extended investigation has been made, with a view of ascertaining the relative weight of the brain to the body in different species of birds, the result of which is appended below.

An interesting fact developed from these figures is that there is considerable individual variation in the weight of the body and brain in different individuals of the same species;[2] this is no doubt dependent in some way upon the time of year, the amount of food supply, and individual idiosyncracy;[3] there is no sexual distinction in regard to the relative weight of the brain to the body—but, on the contrary, male and female alike offer marked degrees of fluctuation in this regard. Exception, however, exists in the two specimens of different sexes of *Harporhynchus rufus*, which closely coincide in their relative weights.

Most of the specimens considered here were taken at Grand Crossing, Illinois, the remaining ones in Chicago. Light loads of

[1] Vol. xxi., April, 1887, p. 389.
[2] Notice especially the series of weights of *Dendroica æstiva*.
[3] Notice a specimen of *Dendroica æstiva*, taken June 4th, which weighed more in body and brain than any specimens of the same species taken before that date.

the so-called "dust" shot was used in shooting the specimens, which, as soon as they were killed, were placed in a cool place, and weighed within a few hours afterwards. It takes twelve of these dust shot, by actual count, to equal a grain weight, and advantage of this fact was taken into account in estimating the weight of the shot that passed through the skin of the specimens, and subsequently deducting this after the weights of the individual had been taken. This was obviously of little importance in the ultimate result; however, every precaution was taken to avoid errors. The weight of the brain and body are given separately, and the relative weight of the former to the latter, all the weights being designated in grains, as a matter of simplicity. In the weighing of the specimens the bird with all its parts intact was laid upon the scale-pan of a prescription scale similar to those used in apothecary stores, which weigh accurately to half of a grain. After being weighed and noted, the brain of the specimen was carefully removed[1] by making a circular incision, and the removal of the piece of bone, thereby cut free, from the posterior part of the cranium by means of a small scalpel. The opening that remains after the operation being sufficiently large to admit of the withdrawal of the entire encephalon after the optic nerves have been severed and the spinal cord likewise treated below the medulla oblongata. After the brain was removed in this way it was weighed upon a more delicate saddle-back scale, which weighed accurately as low as the tenth of a grain. Forty-seven birds were thus weighed, and for purpose of comparison with some small mammals four adult specimens of the common house mouse, *Mus musculus*, and one specimen of the common gopher, *Spermophilus tredecimlineatus*, are reckoned.

Name of Specimen.	Weight of Body.	Weight of Brain.	Sex.	Relative wt. of Brain to the Body.	Date specimen was taken, 1887.
Turdus aliciæ	$589\frac{1}{2}$	12	♀	1-49	May 20th
Turdus ustulatus swainsonii	445	$12\frac{1}{2}$	♀	1-36	"
Turdus aonalaschkæ pallasii	430	$12\frac{1}{2}$	......	1-34	April 15th
" " "	420	$13\frac{1}{2}$	......	1-31	"
Galeoscoptes carolinensis	546	$14\frac{3}{4}$	♂	1-37	June 4th
Harporhynchus rufus	$1158\frac{1}{2}$	$26\frac{1}{2}$	♂	1-44	"
" "	1170	$26\frac{1}{2}$	♀	1-44	"
Regulus calendula	$92\frac{1}{2}$	$5\frac{1}{2}$	♂	1-17	Oct. 5th
Regulus satrapa	$97\frac{1}{2}$	$4\frac{3}{10}$	......	1-22	
Parus atricapillus	$176\frac{1}{2}$	$10\frac{1}{2}$	♂	1-17	Feb. 26th
" "	$159\frac{1}{2}$	9	♀	1-17	"

[1] This did not necessitate any injury to the skin, as it was removed by the regular method that is employed in the skinning of birds for scientific study.

Dendroica æstiva	151	$6\frac{1}{4}$	♂	1-24	May 13th
" "	130	5	♀	1-26	"
" "	127	5	♀	1-25	"
" "	130	$5\frac{1}{2}$	♂	1-23	May 20th
" "	$138\frac{1}{2}$	$6\frac{1}{2}$	♀	1-21	"
" "	$137\frac{1}{2}$	6	♀	1-22	"
" "	167	7	♀	1-24	June 4th
Dendroica maculosa	$136\frac{1}{2}$	$5\frac{1}{2}$	♂	1-25	May 13th
" "	107	$5\frac{1}{4}$	♂	1-20	"
" "	122	$5\frac{3}{4}$	♀	1-21	May 20th
Dendroica blackburniæ	134	$5\frac{1}{2}$	♀	1-24	"
Seiurus aurocapillus	255	$10\frac{1}{4}$	♀	1-25	May 13th
" "	264	11	♀	1-24	May 20th
Setophaga ruticilla	$59\frac{1}{2}$	$4\frac{3}{4}$	♀	1-13	"
Vireosylvia olivaceus	$355\frac{1}{2}$	9	♂	1-39	"
" "	$304\frac{1}{2}$	9	♀	1-34	"
" "	238	$9\frac{1}{2}$	♀	1-25	"
Petrochelidon lunifrons	$422\frac{1}{2}$	8	♀	1-53	May 21st
" "	$375\frac{1}{2}$	$8\frac{1}{4}$	♂	1-45	"
" "	290	$8\frac{1}{2}$	♀	1-34	"
Carpodacus purpureus	438	$13\frac{1}{4}$	♀	1-31	May 10th
Spinus tristis	181	7	♂	1-27	April 15th
Zonotrichia leucophrys	366	14	......	1-26	"
" "	400	15	......	1-26	"
Spizella socialis	$173\frac{1}{2}$	$7\frac{1}{2}$	......	1-23	
Spizella pusilla	279	11	......	1-25	April 15th
Junco hyemalis	284	10	♀	1-28	"
Melospiza fasciata	377	12	......	1-31	"
Dolichonyx oryzivorus	503	$15\frac{1}{2}$	♂	1-33	May 20th
Molothrus ater	637	$18\frac{1}{4}$	♀	1-35	May 30th
Cyanocitta cristata	1312	46	♂	1-29	June 4th
Trochilus colubris	45	$1\frac{85}{100}$	♂	1-24	Sept. 24th
Nyctala acadica	1153	$55\frac{1}{4}$	♀	1-21	Nov. 2d
Tringa minutilla	$388\frac{1}{2}$	$8\frac{1}{2}$	♂	1-45	Aug. 16th
Hybrid domestic canary	$346\frac{1}{2}$	$8\frac{1}{2}$	♂	1-40	
Passer domestica	444	14	♂	1-32	

Name of Mammal.	Weight of Body.	Weight of Brain.	Sex.	Relative wt. of Brain to the Body.	Date specimen was taken, 1887.
Mus musculus	318	$5\frac{1}{2}$	♀	1-58	June 6th
" "	256	6	♂	1-43	June 10th
" "	248	6	♂	1-41	June 10th
" "	$295\frac{1}{2}$	6	♀	1-49	June 11th
Spermophilus tredecimlineatus	2647	$35\frac{1}{2}$	♂	1-74	June 4th

Aquatic Respiration in the Muskrat.—During the winter of 1879–80 I spent much of my time trapping the muskrat, and had rare opportunities for studying their habits. I have frequently observed an ingenious device, to serve as an apparatus for aquatic respiration, resorted to by the animal when driven from its burrow into a pond frozen over. In attempting to cross the pond under the ice, if the pond is too wide for the muskrat to "hold its breath"

until it reaches the opposite shore, it will stop for a few moments and exhale the air which is held down by the ice. Interchange of gases takes place between the air and water, when the animal re-breathes the air and makes another start, repeating the act until the shore is reached. I do not claim this as an original observation; others than myself have noticed it. It is well known by those who have observed the phenomenon that if the ice is struck immediately above the air, and the air thus scattered into numerous bubbles, the muskrat drowns. Having noticed an account by Professor Comstock of the use, by the "water boatman" of a bubble of air for a tracheal gill,[1] I would call attention to this interesting feature in the physiology of respiration of the muskrat.—*W. L. Spoon, Univ. N. C.*, May 1, 1888.

ZOOLOGICAL NEWS.—CŒLENTERATES.—Dr. G. Hubert Fowler, in the fourth part of his papers on the anatomy of the Madreporaria (*Q. J. Ms.*, 1888) discusses the structure and systematic positions of the genera Madracis, Amphihelia, Stephanophyllia, Stephanotrochus, Stephanaria, Pocillopora and Seriatopora. The points made are mostly of minor importance, except that certain cells described as coral-forming (calycoblastic) cells, occurring in several genera really function to hold the mesenteries more firmly to the corallum.

ECHINODERMATA. — The number of species of Asteroids collectd by the French scientific expedition to Cape Horn is thirty-eight, twenty-three of which are new, while thirty-two were not represented in the museum of the Jardin des Plantes. The number of species known from the southern point of the American continent now reaches fifty-seven. M. E. Perrier finds great variability in each species, correlated with the varying conditions under which they exist.

WORMS.—Beddard describes (*Quart. Jour. Micro. Sci.*, 1888) the anatomy of the earthworm *Allurus tetraedrus*, pointing out the features in which this genus differs from Lumbricus and Allolobophora.

MOLLUSCA. — M. H. Fol, in a recent note on striated muscular tissue among the invertebrates, acknowledges that his statement, in a previous communication, that true muscular tissue does not occur in any mollusc is erroneous, since such tissue forms a portion of the adductor muscle of Pecten.

M. H. de Lacaze-Duthiers, as a result of his extensive analytical studies upon the nervous system of the Mollusca, proposes a new classification of the gasteropoda, based upon the differences in the structure of the nervous centres.

[1] Am. Nat., June, 1887.

The marine shells of Fernando Noronha, and indeed most of the marine fauna and flora, are by H. N. Ridley stated to show affinities to those of the East Indies. The species Trochus have a southern distribution.

CRUSTACEA.—Another part of Dr. De Man's Crustacea of the Mergui Archipelago has appeared, embracing pages 177 to 240, and plates 13 to 15. It includes the conclusion of the Grapsidæ, the Leucosoids and the major part of the so-called Anomura. The series is especially valuable from the fact that the author has had access to the types of the French carcinologists. So far the species enumerated number 135.

M. M. Chevreux and Guerne call attention to the amphipod, *Cyrtophium chelonophilum*, a commensal of *Thalassochelys caretta*, seventy-seven specimens of which have been collected in the scientific voyages of the Prince of Monaco. This species differs from those previously known by the shortness of the antennæ, and is probably a native of both hemispheres.

After Rathke, in 1837, noticed the curious fact that the Palæmons infested by Bopyrus belonged exclusively to the female sex, all succeeding authors have confirmed his observations. Nevertheless, guided by previous discoveries concerning the effects of parasitic castration among certain decapodous crustaceans infested by the Rhizocephala, M. Giard last year gave forth the hypothesis that the facts noticed by Rathke were true in appearance only, and that though all the Palæmons found with Bopyrus seem to be of the female sex, this was really the result of the atrophy of the male organ produced by the parasites. M. Giard has recently been able to verify this supposition, both on European and other species of Palæmon.

MYRIAPODS.—C. H. Bollman publishes in a small pamphlet without indication of place of publication, a preliminary list of the Myriapods of Arkansas. Forty species are catalogued, of which nine are regarded as new.

FISHES.—Mr. George Brook (*Proc. Royal Phys. Socy. of Edinburgh*, x.) monographs the British species of the genus Zeugopterus, enumerating three species, *Z. punctatus*, *unimaculatus*, and *papillosus*, the last being a new species found in the Clyde.

Mr. Geo. Brook (*Proc. Roy. Soc. Edinburgh*, 1887) states that in the trout the segmental duct arises from the ectoderm. Its first appearance is in an embryo of twenty-seven days, when it forms a well-marked thickening in the middle trunk region. The lumen of the duct arises as an irregular cavity, and later the whole tube separates from the ectoderm and sinks into the intermediate cell mass. Some observations that he has made on the chick seem to indicate that a similar origin of the duct occurs in birds.

According to the observations upon the food of fresh-water

fishes, made by S. A. Forbes, and forming Article VII. of Vol. III. of the *Bull. Ill. State Lab. of Nat. Hist.*, eighty-three per cent of the food of the burbot consists of fishes, while *Esox lucius* takes ninety-nine per cent. of fishy food. Dorosoma feeds chiefly on fine mud containing about twenty per cent. of vegetable debris; the golden shad principally on fish; and the Catostomidæ, fifteen species of which occur in Illinois, consume molluscs and insects almost in equal ratio. The stone roller (Hypentelium), which in its habits simulates the Etheostomatidæ, feeds, like the members of that family, almost solely upon the larvæ of aquatic insects. The cat-fishes are nearly omnivorous, and are the only habitual scavengers among the common fishes of Illinois. Amia seems to feed upon Crustacea, fishes, and molluscs, with very little mixture of insect food; the gars entirely on fishes; and the singular Polyodon chiefly upon minute insects and crustaceans, especially the former. Professor Forbes thinks it probable that Polyodon employs its paddle-like snout to stir up the weeds as it advances along the muddy bottom, thus driving the animal forms within reach of its branchial strainer, while the mud and vegetation have time to settle.

Though in the deep-sea fish-fauna no distinct bathymetrical zones, characterized by peculiar forms, can, according to the "Report on the Scientific Results of the Voyage of H. M. S. Challenger," be defined, the abundance of fish-life decreases with the depth, as is shown by the number of species (232) found between 100 and 300 fathoms, as compared with 142 between 300 and 500 fathoms, 7 between 500 and 700, 56 between 700 and 1500, 24 between 1500 and 2000, and 23 below 2000 fathoms.

Partially grown examples of several species of freshwater fishes have recently been successfully introduced into Chili from France. The principles followed in arranging the methods for this long transport, involving five changes previous to the accommodation of the water-cylinders on the steamer Sarata, were as follows: (1) The preservation of the same water. (2) Absence of alimentation. (3) Refrigeration. (4) Continual circulation of air. One hundred California salmon, about twelve centimetres long, forty carp of fifteen cent., twenty tench of twelve cm, sixty eels of thirty cm, twenty barbels, and some burbots, minnows, etc., formed the consignment; out of which thirty-nine salmon, together with all the tench, carp and eels, arrived safely. Many of the other species died.

Dr. J. Brock (*Zeit. für Wissen, Zool.*, 1887), describes a singular appendage present immediately behind the anus in the Siluroid genus *Plotosus*. The apparatus in question consists of a tree-like bunch of small bladders of cavernous, and therefore, probably of erectile nature. The fishes of this genus are much feared on account of the terrible and often fatal wounds caused by their fin spines.

Prionurus maculatus Douglas-Ogilby is a new Australian species obtained at Port Jackson.

Dr. A. Günther (*P. Z. S.*, 1887) describes *Latilus fronticinctus* and *Platycephalus subfasciatus* from the island of Mauritius.

Among the fishes collected by Mr. C. Buckley, in Eastern Ecuador, and described by G. A. Boulenger (*P. Z. S.*, 1887), are three new species of Pimelodus, one of Chætostomus, and *Nannoglanis fasciatus*, a new genus and species of Siluridæ. Among the Characinidæ, *Parodon buckleyi*, *Pia ucina elongata*, and *Leptogoniates steindacheri*, are new, while *Sternarchus curvirostris* is a new Sternopygid.

Reptiles and Batrachia.—Mr. Garman catalogues (*Bulletin Essex Inst.*, ix., p. 119) a collection of Reptiles and Batrachia collected by Dr. Edward Palmer in Texas and Mexico. In all fifty-six species, represented by several hundred specimens. The series of young forms and adults is in some cases very complete. The only new form described is *Crotalus palmeri*, from Monclova, Mexico, which the author regards as a variety of *C. tigris*, though he has not applied to it the trinomial system he advocated a few years ago.

Fred A. Lucas discourses the ever-new question, "Do snakes charm?" in the third number of the *Journal Trenton Nat. His. Soc.* He concludes that the whole effect lies in the person, and that it is no property of the snake.

The warts which appear at certain seasons upon many males of *Rana temporaria*, form the subject of a communication to the *Zeitschrift für Wissenschaftliche Zoologie*, 1887, by O. Huber.

Among the reptiles of Noronha are a species of Amphisbæna, a skink (*Euprepes punctatus*) and a gecko. Batrachians and fresh-water fish are absent.

According to G. B. Howes, the low rank assigned the Discoglossidæ, by Cope, receives confirmation in the distribution of the azygos veins. The same veins led him to the view that their absence in Pelodytes pointed to the Pelobatoid rather than the Discoglossoid relationship of that genus.

The collection of eleven species of Batrachia, and thirty-two forms of Reptilia, brought from Greece, Asia Minor and Grecian Islands, by E. V. Oertzen, is utilized by Dr. Boettger, to throw light upon the sources from which the Ægean Islands received their reptilian fauna. Three of the Batrachian forms are common to the islands and to the mainland on both shores of the Ægean, and may therefore be presumed to be autochthonous, while a fourth is wanting in Candia only. Seven reptiles are spread throughout, and are thus to be considered as belonging to the original stock of the islands. Ten species, otherwise common to Greece, Asia Minor and the islands, are not found in Candia, which has one species of African origin. From the west two species have spread as far as Candia, and three

others have not yet reached that island. Eight forms occur only in Asia Minor and its coast islands.

M. Dollo attacks the conclusion of Dr. Baur that the Atheeæ (Sphargis, etc.,) are descended from the Thecophora. He argues that if the carapace of the Atheeæ is formed, as maintained by Dr. Baur, by delamination into a mosaic of the carapace of a Thecophorous ancestor, fontanelles ought to exist as in the other Chelonians, which is not the case. Moreover, the oldest genera of Atheeæ were without dorsal armor. The fact that the plastron of Sphargis is more reduced than that of the other Chelonians goes indeed to show that the Thecophora cannot be descended from the Atheeæ, but it does not indicate the reverse of this. Dr. Trouessart, from various considerations, inclines to the belief that the two groups have descended from a common ancestor by diverging paths.

Birds.—George F. Atkinson gives a preliminary catalogue of the Birds of North Carolina, consisting of a list with notes of 255 species and sub-species already observed and an appendix enumerating eighty-one more which may reasonably be expected to occur. In the prefatory account of previous work on the avifauna of the State no mention is made of the labor of Coues and Yarrow at Fort Macon.

According to Mr. A. C. Smith, the author of a recently issued work upon "The Birds of Wiltshire" (Eng.), the Bustard, which in English popular opinion is always more associated with the Wiltshire Downs or Salisbury Plain than with any other part of the country, became extinct there about the year 1820. There seems, in fact, to be no printed account of its occurrence in Wiltshire after that of Montagu in 1813. The Bustard was not extirpated in Suffolk until 1832, nor Norfolk until 1838.

I. H. Gurney gives in "The *Zoologist*" a list of eighteen reported occurrences of *Sterna caspica* in Great Britain, the last in 1880. It is readily identified by its red beak.

The land-birds of Fernando Noronha, according to H. N. Ridley, comprise a Dove, a Tyrant, and a Vireo, yet the group of islands is but 194 miles east of Cape San Roque.

Mammalia.—It seems, from Mr. Harting's notes in "The *Zoologist*," that of late years the European mole has extended its range in Great Britain. Writing in 1874, Bell observes that "the mole is not found in the northern extremity of Scotland, nor in the islands of Orkney and Zetland." Alston, writing in 1880, remarks that it was at that date well known in Sutherland and Caithness. Though absent from the island, it is common in Anglesea and in Ayrshire, on the opposite coast. Albino moles are not uncommon.

The only herds of wild white cattle now existing in Great Britain are at the following places: Chartley Park, near Uttoxeter,

Staffordshire (probably enclosed by the middle of the thirteenth century); Chillingham Park, near Belford, Northumberland (possibly enclosed before 1220); Cadzow Park, Lanarkshire; and Somerford Park, near Congleton, Cheshire. Cadzow Park occupies a portion of the old Caledonian Forest. At Blickling and Woodbastwirch, both in Norfolk, offshoots (domesticated) of the herd which once was kept at Middleton Park, Lancashire, still exist. The herd (enclosed at the end of the fourteenth century) at Lyme Park, near Disley, Cheshire, is now extinct. Other herds existed until recently at Colly Deer Park, Ardrossan and Drumlanrig, all in Southwestern Scotland.

Dr. E. L. Trouessart's catalogue of the Carnivora, living and fossil, comprises nearly 700 species. The group is divided into two sub-orders: the Creodonta and the Carnivora Fissipedia, the first of which is arranged under the families Arctocyonidæ, Mesonychidæ, Hyænodontidæ, Leptictidæ, Oxyænidæ, and Miacidæ. The Canidæ are placed with the Arctoidea, which thus corresponds with the Hypomycteri of Cope.

ENTOMOLOGY.[1]

New Instances of Protective Resemblance in Spiders.—Within the past two years two interesting cases of protective resemblance have come under my observation. A small species, *Thomisus aleatorius* Hentz, is remarkable for having the two anterior pairs of legs very long, while the two posterior pairs are very slender and short. The spider is very common on grass. One summer day, while reclining in the shade, I watched an individual of this species as it passed from one culm to another. Soon it ran up the stem a short distance and suddenly disappeared from view. For some time I was greatly puzzled as to the manner of disappearance. Upon close scrutiny I saw the spider clinging with its posterior legs to the stem. Its two anterior legs on each side were approximated and extended outward, forming an angle with the stem, strikingly similar to the angle formed by the spikelets.

An undescribed species of *Cyrtarachne* mimics a snail shell, the inhabitant of which during the summer and fall is very abundant on the leaves of plants in this place. In the species of *Cyrtarachne* the abdomen partly covers the cephalothorax, is very broad at the base, in this species broader than the length of the spider, and rounds off at the apex. When it rests upon the under side of a leaf with its legs retracted it strongly resembles one of these snail

[1] This Department is edited by Prof. J. H. Comstock, Cornell University, Ithaca, N. Y., to whom communications, books for notice, etc., should be sent.

shells by the color and shape of its abdomen. The two specimens which I collected deceived me at first, but a few threads of silk led me to make the examination. The spider seemed so confident of its protection that it would not move when I jarred the plant, striking it several hard blows. I pulled the spider forcibly from the leaf, and it did not exhibit any signs of movement until transferred to the cyanide bottle. The cocoons which I have found here are also protected by mimicry. They are essentially like those of *Cyrtarachne bisaccata* Emert.[1] They are dark brown, about 12 mm. in diameter, and are provided on two opposite sides with stems made of the same colored silk, about 5 mm. in diameter. The whole structure, which is hung in the branches of some weed, strongly resembles an insect gall made on the stem of some plant. As the species seems to be new, I append a description.

Cyrtarachne multilineata, n. sp. Middle eyes on a slight elevation, forming a trapezium, the posterior a little larger and farther apart than the anterior. Side eyes at a distance, very close to each other,also on a slight elevation. Cephalothorax brownish, rising gradually from the low head to the abdomen, which partly covers it, not narrowed behind the eyes, convex on the sides, covered with minute pointed tubercles, the two dorsal elongated prominences ending each in two blunt points. Abdomen triangular, sides slightly convex, angles rounded, ventral surface deeply concave. Anterior one-third of abdomen hair brown mottled with the ground color—ecru drab—a pair of large spots of the ground color near the posterior edge of the brown. On the posterior part of the abdomen are several transverse bars of hair brown, becoming successively narrower and shorter toward the apex. Four of the muscular impressions very deep. Sides and posterior part of the abdomen densely marked with hair, brown depressed lines, starting from near the centre of the ventral surface, and passing up over the dorsal surface of the edge, four of those on the posterior part passing up nearly to the posterior pair of deep muscular impressions. On the ventral surface there is a rectangular spot extending from the spinnerets to the anterior edge, the anterior half of this brown, the posterior white; the depressed lines arise from the sides of this spot. Legs light colored. Described from two females. Length of the larger 13 mm., abdomen 15 mm. broad, 10 mm. long; length of the smaller 11 mm., abdomen 13 mm. broad, 9 mm. long. —*George F. Atkinson, University of North Carolina, Chapel Hill, N. C.*

Note on the Tube-inhabiting Spider, *Lycosa fatifera* Hentz. —There seems to be a general impression that the tube-building Lycosidæ do not use their holes for such a permanent abiding place as do the species of trap-door spiders. Good authorities hold

[1] Trans. Conn. Acad. Sci., vol. vi., 1884, p. 325.

that a majority, and perhaps all, use the tube only as a winter resort, or for a retreat in the summer during the time of molting, though the testimony upon this point is by no means universal. There seems good reason, however, for believing that very nearly all desert their tubes during the spring and summer, at times, and wander in search of their prey. Indeed, there are indications that there are latitudinal, as well as seasonal variations in the habits of the family, *i.e.*, that in northern latitudes proportionately a greater number make no tubes than in southern latitudes. The latitudinal variation might be called generic, in that many species of the genus in northern latitudes hide away under stones, etc., making no tubes at all; while in southern latitudes many other species of the same genus construct tubes, some few using them habitually; many others temporarily. On the other hand, the seasonal variation might be called specific, in that most species, in any latitude, which construct tubes use them only during inclement seasons, or during periods of weakness. One species I have observed here, *Lycosa fatifera* Hentz, habitually uses its tube at all seasons; never, or very rarely, wandering in search of prey. I have many times watched them resting at the opening of the tube, waiting for passing insects. They will dart back into their tubes when alarmed. Hentz reported this species from Massachusetts and Alabama. I have made special investigations upon the species in North Carolina, with a view to establish, if possible, the identity of Hentz's species *fatifera*, and the correctness of his statement that it uses the tube habitually at all seasons. The species can be easily recognized from Hentz's description. The one I find here is the piceous variety, which Hentz reported from Alabama, and not the typical form from Massachusetts.—*Geo. F. Atkinson, University of North Carolina.*

EMBRYOLOGY.[1]

The Several Functions of the Enamel Organ in the Development of the Teeth of Mammals and on the Inheritance of Mutilations.— As long ago as 1880 Dr. A. Von Brunn[2] called attention to the fact that the cross crests of the crowns of the molars of the common grey rat were not completely covered with an enamel coating before eruption. The figures then published by Von Brunn showed that the *membrana adamantina* of the enamel organ possessed the characteristic columnar structure

[1] Edited by Prof. Jno. A. Ryder, Univ. of Penna,, Philadelphia.
[2] Notiz über unvollkommene Schmelzentwickelung auf den Mahlzähnen der Ratte Mus decumanus. Arch. f. mik. Anat. XVII., pp. 241–243, pl. XXVII.

over those portions of the tooth covered by true enamel, while at the apices of the cross crests the enamel organ had suffered degeneration of its inner columnar layer and apparently also the reticular portion, as a result of which the organ, just over the crests, had acquired the character of a stratified squamous epithelium. Here and there ragged masses of this tissue seemed to project into the surrounding tissues of the mucous membrane, as if dragged out of place by the gliding of the crowns of these young molar teeth of opposite jaws over each other. These results were obtained from a study of longitudinal sections of recently born rats, with the eyelids still closed, but with the incisors just breaking through the gums.

The great value which the present reviewer attaches to Dr. Von Brunn's earlier observations does not lie in the new histological relations established, but in the discovery that the enamel of the cross-crests of the crowns of the molars fails to develop in the embryo in a situation corresponding to the point where abrasion in the adult through use has slowly worn away this enamel covering and exposed the dentine underneath. This mutilation (for such it is, although produced by an exceedingly slow process of wear), has very clearly been transmitted through heredity. That Dr. Von Brunn should have failed to draw this conclusion from his facts is somewhat surprising, and while glad to call attention to his very important observations, the present writer is of the opinion that these discoveries are amongst the most important made during the present decade as throwing new light upon the method of the evolution of organisms.

In a second memoir [1] Dr. Von Brunn continues his investigations, and adds greatly to his preceding observations. He finds, in fact, that in still earlier stages of the enamel organs of the several kinds of teeth are not different from those normally observed in other mammals, as shown by the tooth germs of the incisors of a uterine embryo of the rat 28 mm. in length. The enamel organs in this last instance are simply cap or dome-like bodies, in which there is as yet no differentiation of the anterior wall as the permanent enamel germ of the enamel band on the anterior face of the incisors of the adult. This is clear proof that profound changes must be suffered by the enamel organ from its earliest appearance until its full differentiation, portions of which evidently must later become either functionless or acquire a new or modified function. This is just what Von Brunn's later researches most conclusively prove. They show, in fact, that in the rat the enamel organ becomes functionless across the transverse crests of the molars before eruption, thus leaving the tooth to erupt with its dentine uncovered at those points. The remainder of the enamel organ which

[1] Ueber die Ausdehnung des Schmelzorganes und Seine Bedeutung für die Zahnbildung. Arch. f. mik. Anat. XXIX. Hft. 3. pp. 367–383, pls. XXI–II, Bonn. 1887.

forms the enamel of the crowns of the molars develop hard enamel, but the portion which extends down over the root and cervix of the molars undergoes degeneration, and its cells lose their columnar form and degenerate into radiating fibres of considerable length, which send their free ends into the surrounding alveolar periosteum. These fibres persist even to adult age, and can be readily seen extending from the tooth into the wall of the alveolus in sections of the entire heads of adult white mice (*Mus musculus*) prepared by the present writer during the last winter. These fibres evidently serve to securely anchor the teeth into the alveolus of the adult, so that the enamel organ is found to have not simply the function usually ascribed to it, but another equally important, namely, the production of these anchorage fibres. Still deeper down in the alveolus the extreme inferior edge of the cap or dome-like enamel organ seems to become quite degenerate and functionless. Such functionless marginal portions of the enamel organ are found in the young of man, the ox, and the rat and mouse. The enamel organ is regarded by Von Brunn in fact as a sort of mould in which the dentine or pulp covered with odontoblasts assumes a definite form. Von Brunn concludes his second memoir with the observation that he considers that he has shown that in the Mammalia, wherever dentine is developed, that the epithelial sheath or cap concerned in the formation of enamel must have first existed. This explains the existence of the enamel organ in the armadillo (Tomes, Q. Jour. Mic. Sci., 1874).

The enamel-forming portion of the enamel organ, after eruption of the molars, is, of course, cast off entirely, or at most persists only as the *enticula dentis.* The portion giving rise to the anchorage fibres of the root persists, as may be seen in longitudinal sections of the molar teeth of adult animals in place in the jaw. In the incisors of the rat, on the contrary, the enamel organ has a more complex history. While it does not differ entirely from the germs of the other teeth in an early stage of development, as all parts of its wall are alike thick, later the anterior wall of this primary enamel organ becomes the persistent enamel organ of the enamel band on the anterior face of the incisors, and thickens, while over the sides and back of the tooth it degenerates and gives rise to the anchorage fibres of these teeth, as shown by Von Brunn, and as confirmed by sections of later stages in my possession.

While the data in which Von Brunn has supplied us are of great interest, there are some which I can add from stages of the development of the teeth of the common mouse, which are of interest in connection with the history of the form of the molars of these commonest of Rodents. A little while before birth the enamel organs of the first and second molars are connected by an isthmus, and it is probable that the germs of the second and third molars are also thus joined together. In longitudinal sections of the heads of young mice it is, however, of great interest to note that the cross crests of the upper molars have their apices directed

backwards and downwards, while the apices of the lower molars slope forward and upward, just as they do in the adult, yet at this stage there has been no enamel or dentine formed. This fact shows that the forms of the crowns are foreshadowed in the germs of the teeth before calcification, and it now becomes possible to assume, for the first time with a reasonable show of probability, that this forward and rearward deflection of the molars is due to an inherited impress or modification induced by the characteristic mode in which the grinding teeth were used in the Rodentia. Because it may be assumed that the manner in which the teeth are used would slowly affect pattern of the crowns, as the writer first tried to show in his essay "On the mechanical genesis of tooth-forms" (Proc. Acad. Nat. Sci. Phila., 1878). It follows that if physiologically induced mutilations may be inherited, as the results of Von Brunn seem to demonstrate, it is almost equally certain that mechanically induced changes of form slowly caused by the normal mode in which the teeth were used could be inherited with probably even greater readiness.

Dr. W. Xavier Sudduth has shown that the reticulum of the enamel organ becomes thinner at the apex of the young tooth. In this way he has also shown that the *membrana adamantina* or inner tunic and outer tunic are approximated while the blood vessels from the adjacent connective tissue are pushed toward the enamel organ to supply it with nutriment and probably aid very considerably in the rapid deposit of the enamel from above, in just the same way as the vascular pulp would supply the conditions for the rapid deposition of the dentine from below. That the enamel organ of the fœtus is supplied by a vascular plexus as assumed by Sudduth is, I think, completely demonstrated by the fact that I find a fine vascular plexus in immediate external contact with the persistent enamel organ of the incisor teeth of the adult white mouse.

The great value which is to be attached to the fact that abrasions of the enamel of the adult, which have reacted upon the funtional activity of the enamel organ of the embryo rat, so that such mechanically induced alterations could be inherited, does not consist so much in the proof it affords that mutilations may be inherited as it does that mutilations incurred in the ordinary struggle for existence, may, under certain conditions in certain practically feral species, be transmitted. The cases which have hitherto been appealed to as proving that mutilations could be inherited are without exception artificial; in the remarkable example of the already abraded apices of the molars of young mice and rats, we have an example of the apparently constant transmission of a mutilation quite independent of any artificial interference whatever. This datum, which has until now been wanting, is therefore at last supplied, and Lamarckianism has found in this the most irrefragable proof of the soundness of its principles. This datum, in fact, is the one needed, as admitted by Weissman, the greatest recent opponent of Lamarck, to place the latter's doctrine in the positions of formidable rivalry to those of Darwin. — *J. A. Ryder.*

PSYCHOLOGY.

THE RELATION OF WILL TO THE CONSERVATION OF ENERGY.[1] —It is generally supposed that the designed movements of animals exhibit the quality of design by reason of a direct influence exercised by conscious states. It is supposed that an animal eats and drinks because it *feels* hungry and thirsty; that it changes its position because it *feels* that position to be uncomfortable, on account of muscular weariness, unpleasant temperature, or some other reason which is consciously felt by it. Such acts are termed voluntary. They are distinguished from the automatic, which are performed either in the absence of consciousness of them or without that relation of consciousness to them which is seen in the voluntary acts. The peculiar influence exercised by conscious states over acts is termed *the will*. Ordinary will must be distinguished from "free will," since its action is a necessary outcome of "motives" or reasons which pre-exist in the mind; while "free will" is supposed to be spontaneous in its action. With the latter supposititious faculty I have nothing to do in the present paper.

The physiological action of will is as follows, so far as it has been possible to trace it. An impression or stimulus received by a sensory nerve—generally at the surface of the body—is conveyed by it to the posterior column of the chorda spinalis, and is thence transmitted through the optic thalamus to some point in the gray tissue of the posterior lobe of the cerebral hemisphere. Thence a stimulus is conveyed by some of the fibres of the white substance to the anterior part of the gray cortex. Thence it returns downwards, conducted by white fibres, to the corpus striatum, and thence to the anterior column of the spinal cord. From this the stimulus is conducted along the motor nerve to the appropriate muscle, where it releases energy, the muscle contracts, and the act is performed. Modifications of this general procedure depend on the source of the original stimulus, whether from an organ of special sense or from an internal organ, etc., and the part towards which the outgoing stimulus is determined.

The locality at which the outgoing stimulus receives its direction is evidently in the cells of the cortex of the lateral and anterior part of the hemisphere. This is evidently the seat of the will.

I must here recall the familiar fact that multitudes of acts which display distinct design are performed by animals without consciousness having any share in the process. There are good reasons for believing, however, that such acts could never have originated in a state of unconsciousness of the actor. I will not enter this subject

[1] Abstract of a paper read before the Philosophical Society of Washington, May 26th, 1888.

fully, but state in brief what the two principal reasons for this belief are. The first is that, according to our experience, animals which meet with conditions injurious to life which do not cause them pain speedily succumb and perish. It is incredible that animals not conscious of hunger, thirst, and changes of temperature should not speedily die. Animals not conscious of fear of more powerful enemies must be destroyed. The second reason for this opinion is, that all designed acts whose history we can trace are the result of *education*. This means, conscious stimuli strong enough to hold the attention and the repetition of movements appropriate to the stimulus and designed to either retain or escape it, according as it is pleasant or painful. Then follows the acquisition of the power of performing such movements with ease, the consequent withdrawal of attention, and ultimately the absence of consciousness of the performance of the act. This is the process of cryptopnoy,[1] by which acts pass from the voluntary to the automatic stage. There is reason to believe that this is the process by which animals have acquired the various remarkable habits which characterize them and which they pursue with such unvarying precision. But most—perhaps all—animals have not, in so doing, abnegated consciousness. They generally possess enough to enable them to act intelligently in the presence of new occasions and to acquire new habits and add to their stock of automatic capacities. This may be better understood by reflecting on the long ages of geologic time during which they have had the opportunity for such education.

I add here that it is highly probable that the movements thus inaugurated and perpetuated have been made the conditions of the environment, the active factor in animal evolution, since it is probably due to such action that the organography of animals has been determined. This is the probable source of the origin of those variations on which natural selection acts. And the view that organic evolution is due to the consciousness at the back of automatism has been called the doctrine of Archæsthetism.[1]

From this digression I return to the question of the nature of the act of will.

The animal organism is a machine for the metamorphosis of energy; and the evidence is clear that this process is performed in strict accordance with the law of the conservation of energy. The exact relation between the amount of work done and the amount of food ingested is well known, whether that work be muscular, mental, or reproductive. The energy which does the work is liberated by the decomposition of the proteids which constitute the food. These highly complex substances break up, and are replaced during work by simpler and more stable ones, which are eliminated from the organism; while the energy which has maintained them is given up and appears as heat, muscular contractions, thought-force, etc.

[1] Origin of the Fittest.

The animal machine is the most perfect converter of energy known, acting with far less waste than any apparatus of human invention.

Every mental act involves conversion or metamorphosis of energy, whether it be a mere sensation or a memory, an emotion, ratiocination or a determination of will. Throughout these processes the law of conservation of energy is necessarily obeyed. But mental acts possess qualities which require further attention in this connection. Mind, *as such*, is not a form of energy. Reducing mind to its generalized expression,—that one which embraces all its phenomena,—viz., consciousness, it is safe to say that its qualities, and hence its definition, are totally distinct from those which we ascribe to, and by which we characterize energy. Energy is motion in one form or another. Consciousness is self-knowledge, from the simplest sensation upwards. No two subjects of thought can be more widely diverse. In fact, it is safe to say that all thinkable things are traceable to three sources;—matter energy, or the motions of matter, and consciousness, or the knowledge which some matter has of itself. But I assumed at the outset of this paper, in common with most other persons, that designed acts are due to the direction and control of currents of energy exercised by conscious states. In this proposition there appears to be involved an assumption that in an act of will the law of the conservation of energy is violated. This, indeed, appears at first sight to be the state of the case; and it becomes necessary that we examine most fully into the process. It is not assumed that energy is created by an act of will, but it is supposed that energy is directed. The creation of energy is unthinkable. Let us see whether the idea of its direction by some thing which is not energy is a fact of experience or not. Believing, as I do, that consciousness, and hence will, is a phenomenon of a material tridimensional basis, and disclaiming the dualistic idea that consciousness is external to and apart from tridimensional matter, it is necessary to explain how such an attribute or quality is capable of exercising control of the movements of such physical basis. Having already expressed the belief that it does so, let us look into the *modus operandi.* I believe that this may be expressed by the following law. *The dynamic expenditure of an act of will has no dynamic relation to the nature of the decision involved in it.*

This law may be illustrated as follows, in the case of the lower animals. An animal which is pursued by another may run into a hole or it may ascend a tree for safety. In the two cases totally different sets of muscles are used. The animal, *for reasons*, elects to use the one set rather than the other set. Another animal may throw one ear forward to catch a sound rather than the other ear. Mechanisms to accomplish the movements of both exist. In this case the animal *directs* the energy to one set of muscles rather than to the other. Or an animal will use both ears alternately, or turn the head from side to side to hear and see what is behind, each time choosing which muscles it will move. This is only the common will of the animal

acting from the simplest of motives—not free, of course, but none the less a remarkable property of protoplasm, conscious and unconscious. No inorganic machine can do this.

What relations do these decisions bear to the amount of energy expended in the resulting act? A physical movement costs energy, and a mental act costs energy. The mental activity incident to a decision of will costs energy, and the more perfectly ratiocination is performed, the more perfectly is the energy consumed and the less dissipated, as heat. But does the decision to use the left hand, eye, or ear cost more or less than the decision to use those of the opposite side? Evidently not. Does the decision to climb a tree cost more than the decision to enter a hole? I venture to say that it costs a man no more to decide to build a house than to decide to stand a brick on end, so far as the act itself is concerned. This is because the act is the outcome of a process of ratiocination or feeling, in which the dynamics are not correlated to the forms of the sensations embraced under those two terms. The fact of anything being done *for reasons* indicates that it takes its direction from other than dynamic sources. The question of the decision is quite different from that of acquiring motives of action. This is a more complex process, for motives are reached by very various routes. But even in attaining motives there can be no equivalency between the energy expended and the mental result.

Of course it may be said that there is no separate act involved in a decision of will. It may be correctly said that the determination is simply due to the predominating pressure of the most important and weighty motives. Let this be accepted as true. It is consciousness, past or present, which knows which are the weighty motives. Like the prism which bends the course of the rays of light, whatever passes through the psychical connection between incoming and outgoing stimulus is determined in accordance with what it finds there, and it is consciousness and its residua which is responsible for the bending. The physiological labor is performed in acquiring the motives which, when acquired, perform acts of will which are incommensurate with energy, both with regard to their own intrinsic qualities and with regard to the objects towards which they act. It is this property of mind which enables it to direct the movements of matter without violation of the law of the conservation of energy.

This fact is of the utmost importance to philosophy and to our conceptions of the universe and of the place of consciousness in it. These decisions, which we term will, are common to all conscious beings, from the bottom of the scale up. Every animal which selects an article of food or which rejects one, for *reasons*, lowly and simple though they be, performs an act of will, and directs energy, and in so far appears to be superior to the law of the conservation of energy. With the lapse of consciousness, such as we see in the vegetable kingdom, acts of will—prop-

erly so called—are impossible. Their automatic residua remain to work blindly forward until such time as the environment changes to unfavorable conditions, when the organism perishes without remedy.—*E. D. Cope.*

ARCHÆOLOGY AND ANTHROPOLOGY.[1]

FRAUDULENT SPEAR OR ARROWHEADS OF CURIOUS FORMS.—We have just received a series (eight in number) of these curious-shaped spear or arrowheads which were transmitted to us for our inspection. We were not informed whence or from whom they were purchased, nor who was suspected in connection therewith. But a slight examination developed the fact that they were spurious. The material used was black and jaspery flint or chert which takes no *patine* with age or exposure. The fresh fractures have much the same appearance as have the ancient ones. A critical examination, however, under the miscroscope, and in other ways knows to the archæologist accustomed thereto, detected the fresh chipping done at the places necessary to make the curious form. We were thus enabled to supply the outline where it had been chipped away, and could see the genuine implement as it was before subjected to the dexterous manipulation, or slight of hand, of this modern manufacturer of spurious flints. Five of the specimens had been made from the common leaf-shaped spear or arrowhead. In two cases stemmed arrowheads were used, and the last was triangular with a concave base. From these original and genuine forms the manipulator had made his curious forms. The originals were worth, say, two cents a piece, but after being subjected to his adroitness their price would be increased to fifty or seventy-five cents. A fine speculation! A law is sorely needed in the United States by which these fine gentlemen can be prosecuted for such deceitful practices, as they now can be for passing base money.

[1] This department is edited by Thomas Wilson, Esq., Smithsonian Institution, Washington, D. C.

The Hemenway Expedition in Arizona. — Dr. Jacob L. Wortman, of the United States Army Medical Museum, has just returned from Arizona, where he has spent the winter and spring attached to the Hemenway Southwestern Archæological Expedition under the direction of Frank Hamilton Cushing, which was mentioned in the March number of the Naturalist, and he confirms the importance as well as the genuineness of the discoveries of Mr. Cushing. The expedition is thoroughly equipped and well organized, and its investigations have been conducted in a vigorous and scientific manner, with special reference to the many details which go to make collections of this character of value to the scientific student. Not only have the ruins been carefully surveyed and mapped, but each specimen has been labelled with great care, in such a manner as to indicate exactly where found, together with all such other facts in connection with it as will be of use to the student.

The expedition has for its object the study of the ancient civilization of the southwest, and if the results of the first year's work can be taken as an index of what it will accomplish, we may confidently look for a solution of this perplexing question. Already a large and valuable collection illustrative of the culture of these prehistoric people has been secured, and it is a matter of congratulation that it has been so collected that the scientific student can get all out of it that it can be made to tell.

Mr. Cushing's ethnological training has been in such a direction as to give him a peculiar fitness for the position which he occupies, having spent six years or more in studying the social institutions, customs, habits, religion and language of the modern Pueblo Indians, and this thorough knowledge of these is indispensable to the proper interpretation of the facts gathered by the expedition. The anthropological work is in charge of Dr. Herman Ten Kate, a native of Holland, son of the distinguished artist of that name. Dr. J. L. Wortman, the Anatomist of the Army Medical Museum of Washington, is his assistant. Mr. Adolph Bandelier, whose knowledge of the early Spanish and Mexican records is well known, is connected with the expedition as historian. Mr. Chas. A. Garlick is the civil engineer and topographer. Mr. Fred. Hodge is the draftsman and secretary, while Mr. Yates is the photographer. Mrs. Cushing and her sister, Miss Margaret Magill, are also members of the party, and have rendered important aid in the classification and care of the specimens. Miss Magill's artistic talents have been of special service to the expedition by reason of her clever sketches and drawings of the specimens *in situ*.

The locality in which explorations have so far been conducted comprises the Gila and Salt River Valleys, situated for the most part in southwestern Arizona. They are fertile tracts of large extent, and there can be little doubt that they were once occupied by a thrifty and prosperous people, whose history remains unwritten. The Rio Salado (Salt River) is the principal tributary of the

PLATE X.

Spurious Arrow Heads, made from genuine bones.

Gila, and affords abundant water to irrigate its valley, a tract including a half a million acres, or more. The land for the most part is covered with cactus, sage brush, grease wood, and mesquite trees, but when cleared and brought under irrigation is made to produce abundantly almost any and all the crops of civilized husbandry. Fruits and cereals grow in profusion, and the land is said to be well adapted to the growth of cotton and tobacco. The land rises from the river at a gentle slope, a fact which is of great importance to a system of irrigation. At the upper or northwestern end of the valley, however, the river is bordered upon the south by a mesa which slopes away to the Gila, no mountains intervening between the streams at this point. Water brought from the Salt River upon this mesa can be made to flow a distance of twenty miles to the south, or into the Gila, and will irrigate a tract many miles in extent. This these ancient people did, and, scattered over this plain from the Salt to the Gila are to be found the ruins of their villages, towns and cities, long since crumbled into dust, and now overgrown with a thick mesquite forest.

Their houses were for the most part built along the main irrigating canals, and are now indicated by irregular truncated mounds, of various dimensions, thickly strewn with fragments of broken pottery. Excavating these mounds, the foundations or ground plans of the buildings were discovered. Some of them were large, often several hundred feet square, and, according to Mr. Cushing, three or four stories in height. They were constructed usually of adobe bricks, but in some instances they enclosed the adobe between rows of upright posts wattled with cane or willow. Each house would contain from two to five hundred rooms, and is thought by Mr. Cushing to have been the house of a clan. A considerable grouping of these communal houses constitutes what Mr. Cushing has called the cities of Los Muertos, Los Hornos, Los Guanacas, Los Pueblitas, Los Acequias, etc. They are not built with the regularity of our modern cities. Los Muertos (the city of the dead) can be traced for three or four miles, and includes some forty or fifty of these great communal structures that have been so far unearthed, but if systematic search be continued double or quadruple this number will probably be found.

A characteristic feature of each of these cities, and one which probably led Mr. Cushing to designate them as such, is a ruin of much greater dimensions than any of the rest, which is invariably surrounded by a strong outside wall, enclosing a considerable space or yard. This enclosed space around the large building or temple is supposed to have been for the purpose of protection in times of war, when pressed by an enemy, and the large building itself served not only as a store house for a reserve supply of provisions, but also, if we are to judge from the remains and implements, was the abode of the ruler or chief priest of the people of the town.

While no accurate computations have been attempted, it is supposed, taking into consideration the number of towns or cities known to have existed in the Gila and Salt River valleys, that the population could not have been less than two hundred thousand. There is every reason to believe that these places were not successively, but simultaneously occupied, especially when we remember that they constructed large irrigating canals for a distance of fifteen or twenty miles, which with their rude implements must have been a gigantic undertaking. Their irrigating system was extensive and complete, and covered almost, if not quite, all the cultivable parts of the two valleys. The present inhabitants of the soil have taken advantage of these ancient waterways, constructed at such expenditure of prehistoric labor, and they now run many of their irrigating canals in these ditches. These ancient canals were constructed with care. A cross section exhibits a series of terraces widening towards the top, so that a large or small quantity of water could be accommodated and a good depth secured. After the canals were dug they were puddled and then burnt, probably by filling them with brush and then setting it on fire, so that they almost equalled terra cotta in durability. Mr. Cushing is of opinion that they were not used for irrigation alone, but for navigation as well. There are indications that they used rafts made of reeds (balsas) for navigating these canals, and this appears more probable from the heavy materials that have been brought from a distance. It seems certain that they floated the pine timber used in their building operations down the Salt and Gila Rivers from the distant mountains; it is too much to suppose that they carried this material upon their backs for a distance of a hundred miles.

The burial customs of these people were peculiar and consisted of two methods, viz., cremation and interment. In the case of the priestly class the body was wrapped in cotton cloths and deposited beneath the floor of the house. Generally the bodies were laid along the east wall of the building, with head to the east, although this custom was not invariable. When a person of this clan died, a grave was dug in the floor, a foot and a half or two feet deep, and the body placed therein; it was then covered with adobe mud and packed firmly around the corpse. When this covering dried, and the soft parts and wrappings disappeared, the skeleton would be found enclosed in a rude sort of sarcophagus. In numerous instances, two, and more rarely three, skeletons were found in one grave. In all such cases of double or triple burial the skeletons indicate that it was male and female, or one male and two females. Buried with each cadaver was a food vessel and a water jar, and sometimes several of each, often highly decorated. That they were wrapped in cloths, presumably of cotton, is evident from the impressions of the cloth made upon the soft adobe covering. Fragments of this material were found and preserved, notwithstanding its decomposed condition.

Connected with each communal structure is what Mr. Cushing aptly terms a pyral mound, since the bodies of the common class were burned and their possessions destroyed upon this spot. The ashes and fragments of the charred bones were collected and placed in a burial urn, which had been previously "killed," and the whole buried in close proximity to the spot. The accumulations of this charred and fragmentary material now make mounds of sizable dimensions, which in itself would indicate a long period of occupancy. In the case of the pyral burials everything was broken and destroyed, while in the priestly burials the accompaniments were always whole. In one case of the priestly burials not only were the usual accompaniments present, but a quantity of arrow points, spear-heads, and a large stone knife, together with numerous turquoise ornaments and materials for inlaying, were found deposited in the grave. This individual Mr. Cushing identified from his paraphernalia as belonging in all probability to the priesthood of some war order, and this seems more probable when we come to examine the skeleton, for he had sustained a fracture of the arm, and one knee was stiff from anchylosis, no doubt the scars of hard-fought battles.

Of the priestly burials something like four or five hundred were unearthed in the various towns, while many more of the cremated remains were found in the vicinity of the pyral mounds. The skeletons, as a rule, were so frail that comparatively few could be preserved. Of the whole number about one hundred good skulls, and probably fifty tolerably complete skeletons, were collected. These were so frail that Dr. Wortman was compelled to use a goodly supply of shellac varnish to keep them from falling to dust. Silicate of soda was tried, but it was not found so good as the ordinary shellac dissolved in alcohol.

The objects which go to make up the collection are various, and consist of those of ornament and utility. Numerous shell carvings, some of which had been beautifully inlaid with torquoise, were found, while a very few copper ornaments in the shape of bells and earrings were also dug up. Their tools consist almost entirely of stone, and were, for the most part, polished, though such implements as potters' stones, rasps, mauls, metates, etc., were never polished. Their stone axes and hatchets are of the ordinary pattern, and are generally well polished; they are of various sizes and shapes, and some of them were no doubt used as picks in digging up the hard cement and gravel in the construction of their irrigating canals. Stone hoes, knives and arrow-heads were also found in abundance.

The collection of pottery is large, and, according to Mr. Cushing, resembles that of the Zuñi manufacture more than any other people. It is often highly decorated with quaint and unique patterns, in various colors, and some fragments exhibited a fine glaze, which indicates a high state of the ceramic art.

That they were acquainted with metals there can be but little doubt, although they do not appear to have made use of it except in the way of ornament. Some places in the neighboring mountains seem to indicate that they mined for ore, which they smelted in crude ovens. Whether this was copper or the precious metals is now difficult to determine, but that they were accustomed to bring these ovens or furnaces to a very high heat is indicated by the slag in their immediate vicinity.

It is perhaps premature to attempt to decide who these people were, to whom they were related, and what became of them, I think it fairly settled by these discoveries that they were the ancestors of the modern Pueblos. Whether or not they were in any way connected with the ancient people of Mexico and Yucatan the future alone can decide. It seems certain, however, that one part of them went north to found the later Pueblo civilizations which are now represented by the Zuñis of to-day.

If historical evidence is worth anything and if we can trust the ordinary evidences of archæology, then these ruins are beyond question pre-Columbian, and may be as much as a thousand years old.

Mr. Cushing's final report will be awaited with interest by all who are in any way interested in the subject. The archæological specimens have been shipped to Salem, and the skeletons will go to the Army Medical Museum in Washington.

The Indians of British Columbia [1] are made the subject of a short article by Dr. Franz Boas, who had the opportunity of studying during three months of the year 1886 several southern tribes of this connection. During that short lapse of time Boas has largely increased our knowledge of their tribes, tribal names, synonymy, and habitat, and has also gathered so much of their dialects as to enable us to divide them into linguistic families. The seven pages of Boas's article (pp. 422–428) presently before us are chiefly filled with mythologic information, which for that special country is almost wholly new to us. Boas believes that the raven legend originally belonged to the Tlinkit and their immediate neighbors, but that, on the other hand, the sun legend originated with tribes of Selish lineage (and many of the other North American Indians, he might have added). Other deities appearing in these parts are Tsonokoa, a mythical form of the grizzly bear; Komokoa, a water spirit, the father of the seals; the Sisiutl, a double-headed snake, and a number of others. British Columbia is perhaps the only spot in North America where cannibalism (a milder sort of it) is still practiced. This is the case among the Tsimpshian and the Indians on the mainland opposite Vancouver Island, who possess a sort of clan called the cannibals,

[1] Proceedings of the American Philosophical Society of Philadelphia, November, 1887.

and a dance peculiar to the rite. From the same author[1] we have received a few other publications, which refer to the sights seen and facts gathered by himself among the distant tribes visited by him.

"THE INDIANS OF BRITISH COLUMBIA," it is an article giving his experiences chiefly among the fishing tribes of the channel between Vancouver Island and the main land. The number of the Indians at present living in British Columbia is put down by Boas at 38,500 (p. 635). "A Year among the Eskimo" in *Bulletin of American Geographical Society*, New York, 1887, pp. 383–402, impart to us some ideas how the Eskimos of the shores of Baffin's Bay make their living during the trying winter season of these high latitudes, and also adds myths and songs of this strange people, especially the Sedna legend. This same legend of the Central Eskimos, together with other stories and traditions, are more especially dwelt upon in "The Eskimo" in *Transactions of the Royal Society of Canada*, 1887, pp. 35–39. Curiously enough, the *thunder* is a prominent feature in the mythology of these frosty climates (p. 37). Mythologic traits of all the Northwestern tribes are discussed in some German articles of Boas in the *Globus* of Braunschweig, 1888; the first of these legends is contained in No. 8, pp. 121–127; the second in No. 10, pp. 153–157. The Sedna legend, together with a considerable number of other mythic tales, legends and stories of these parts, is reproduced in Boas' article: "Die religiösen Vorstellungen and einige Gebränche der zentralen Eskimos," (*Petermann's Mitteil.* 1887, pp., 302–316.) His full enumeration of the villags and settlements of the Kwakiutl people will be found in "Census and Reservations of the Kwakiutl Nation," with map. (*Bulletin of the Am. Geograph. Society*,) 1887, No. 3., pp. 225–232.

"THE GEOGRAPHY AND GEOLOGY OF BAFFIN LAND."[2]—Ethnologic information, whenever obtained with accuracy and correctness, must be published *without delay*. Mindful of this principle, Dr. Boas has, ever since the above was written, been busy in publishing the results of his voyages in various periodicals. Thus we have seen of him, besides the articles in *Globus* appearing as a serial, a treatise of which the title is mentioned above, and another of eleven columns in "Ausland" of Stuttgart, 188, pp. 281–286, entitled, "Die Indianer des britischen Columbia." This paper contains a series of some of the author's most thrilling experiences on his travels on Vancouver Island (east side) and the mainland opposite. The principal myth of these Kwakiutl tribes contains the achievements of Qanikila, or the "Wanderer," who is reputed to be the Son of God, and sent by God from the heavens

[1] Popular Science Monthly of New York, March, 1888, pp. 628–636.
[2] Trans. Royal Society, Canada, pp. 75–78, 1887, and an article of eleven columns in "Ausland" of Stuttgart, 1888, pp. 281–286, entitled, Die Indianer des britrschen Columbia.

to visit all countries of the earth and perform miracles. This belief makes these Indians very accessible to a future conversion to Christianism; but the Catholic missionaries were not successful with them up to this day, because they neglected to use the main impulse for civilizing savages: *to make them work* and earn money.

THE MOTILONES[1] are an Indian nation scattered in numerous bands or tribes through the Eastern Columbian and the Western Venezuelan States, many living south of the Lake of Maracaibo. The Motilones living in the forests and swamps between Zulia and Cesar Rivers, on the border line between the two confederacies, have been very dangerous neighbors to the white settlements ever since the conquest. The name is equivalent to "pelon," *baldheaded*, and also applies to a denomination of monks, who tonsured their hair so as to appear almost baldheaded. It is, therefore, not a name belonging necessarily to one tribe or race only, and indeed we find it repeated in several parts of South America. From 1779 to 1792 the Spanish domination established ten missions among the Motilones on the Zulia, of which even the last trace has disappeared in our days. Dr. A. Ernst, Director of the Ethnologic Museum in Carácas, Venezuela, and one of the few men of education who are active in the furtherance of South American anthropology, obtained from General B. T. Velasco the skull of a Motilone man, about forty-five years old, for measurement. He found it to be chamæprosopic and but a little hypsicpehalic, the index for length and width being 79.9. He describes the skull, adding to his accurate measurements all what is known about the tribe of the Motilones.

At the same session a report by A. Ernst was read concerning the language of the *Tucurá Indians* in the Columbian States. Tucurá is a settlement upon the Upper Sinu, at the mouth of Rio Verde, and these Indians form a population of about seventy. The vocabulary obtained from the traveller, F. A. A. Simons, is printed in the *Verhandlungen*, p. 302, and contains some Carib terms, many of the terms being oxytonized.

Two weeks later, another communication from Dr. A. Ernst was read in the Berlin Society, containing a vocabulary of the Motilon language, the first one ever obtained from that tribe. It was obtained by Mr. George Isaacs, Secretary of the Scientific Commission, presided by the French naturalist, Charles Manoen, and appeared first in the *Anales de la Instruccion publica de los Estados Unidos de Colombia*, VIII., pp. 213–216, Bogotá, September, 1884. Dr. Ernst republished this vocabulary of seventy-two terms, and finds that twenty-four among them connect this language with Macusi, Arekuna, Akawai, and other Carib dialects. Cf. *Verhandlungen* of May 7, 1887, pp. 376–378.

[1] Verhandlungen der Berliner Anthropologischen Gesellschaft, April 23, 1887.

MICROSCOPY.[1]

Improvements in the Paraffin and Celloidin Methods.—The great advantage of the paraffin method is that it permits of making ribbons of thin sections with great rapidity. But material that has passed through this method of imbedding invariably loses something in the *clearness* of its finer histological details, as may be seen by comparison with sections made in elder pith or in celloidin. In some cases structural features are obliterated, or obscured to such a degree as to be beyond detection. As Dr. Apáthy has pointed out, this is especially true of connective tissues and intercellular substances. Can the paraffin method ever be improved so far as to be free from this very serious objection? or can we find a substitute that will have the advantages without the disadvantages of paraffin? Celloidin is free from the objection just mentioned, and it has the inestimable advantage of being a perfect safeguard against brittleness and loss or displacement of loose parts. But the celloidin method is complicated, and does not admit of very thin sections or of ribbon-cutting. Dr. Apáthy has shown us how the serial arrangement of section can be accomplished with the celloidin method, but the process recommended is slow and tedious compared with that of ribbon-cutting. Dr. Kultschizky[2] proposes to combine celloidin with paraffin, and thus to secure the advantages of both and neutralize the defects of each. I have not yet tested Kultschizky's method, but it certainly seems to be the most promising thus far described. It is probable, however, that the *definition* of histological elements will suffer no less by this than by the ordinary paraffin method. Professor Ryder has given the method a trial, and recommends it very highly. Ryder's description is very complete, and, as he suggests some improvements, I shall follow his account.[3]

The Celloidin-Paraffin Method.—1. The object to be sectioned is placed in strong alcohol (97 per cent.) until dehydrated or until fully saturated.

2. It is then placed in a mixture of equal parts of ether and alcohol until saturated, the time varying with the size of the object.

3. It is then transferred to a solution of celloidin, prepared as usual in equal parts of alcohol and ether, and in which it is allowed to remain for twenty-four hours.

4. The object is then placed in oil of origanum until saturated, which will be in from one to two or three hours according to the size of the object.

[1] Edited by C. O. Whitman, Director of the Lake Laboratory, Milwaukee.

[2] Zeitschr. f. wiss. Mikroskopie, iv., 1, p. 48, 1887.

[3] J. A. Ryder. Celloidin-Paraffin Methods of Embedding. The Microscopical Bulletin and Science News, Dec., 1887, p 43

5. It is then transferred from the preceding to a mixture of equal parts of oil of origanum and paraffin, which is kept on a water bath for an hour or more, at a temperature of 40°C.

6. It is then transferred to a bath of hard paraffin, or such as melts at 55°C., and is kept there until saturation is complete.

I have tried this method with specimens of injected spleen, and find it to work admirably. The sections can be cut with a dry knife. The sections form a ribbon more easily than in the case of ordinary paraffin imbedding.

The sections may be freed from paraffin with *chloroform* before mounting if they are required for histological purposes, as they may be handled with the greatest ease on account of the presence of the celloidin which holds them together. They can then be stained in hæmatoxylin (Kleinenberg's) or in nigrosin, or double staining effects may be produced by the use of other dyes in combination with hæmatoxylin.

To many persons the oil of origanum has a disagreeable odor, and is almost as inflammable as turpentine; besides, it darkens or oxidizes in a short time, and has, I think, a tendency to shrink the object slightly, even after treatment with celloidin, and also to darken it.

These disadvantages I have lately avoided by substituting chloroform for the oil of origanum, used by Dr. Kultschizky. I proceed in the same manner as he recommends with the imbedding process as regards the first, second, and third steps. The fourth step is to place the object soaked with celloidin in the usual way in chloroform until saturated, instead of in oil of origanum. It is then transferred to a mixture of paraffin and chloroform, equal parts, kept at a temperature of 40°C., and finally, until complete saturation is effected, in molten hard paraffin melting at 55°C.

To clean the sections for mounting, they may be mounted directly from the chloroform, if the operator is quick enough and does not let the chloroform evaporate from the section before it is covered with balsam. A preferable clearing agent, first proposed by Wiegert, I have found to be a mixture of equal parts of *xylol* and pure white *carbolic acid*, which has been allowed to deliquesce or rendered liquid by heat. This may be applied to the section on the slide with a clean camel's-hair pencil, and will clean the section instantly without in the least attacking the celloidin.

Serial Sections with Celloidin.[1]—The celloidin block, with the object imbedded, is cut as regularly as possible, and fastened to a cork. In sectioning, the knife should be placed nearly parallel with its direction of motion, and after every five to ten sections wet with 95 per cent. alcohol. The sections are raised from the knife with a small brush, and placed on the surface of bergamot oil (in a small glass dish over a white ground). If the oil is good the sections will at once unroll and become transparent.

[1] J. Apáthy. Methode zur Verfertigung längerer Schnittserien mit Celloidin. Mitth. a. d. zool. Station z. Neapel., vii., 4, p. 742, 1887.

Bergamot oil is in every respect the best to use in celloidin technique. Origanum oil may be used, but its action is violent and often causes the colors to fade. Good bergamot oil is clear grass-green, with at most a slight yellow tinge (yellow oil is always bad), does not smell of turpentine, and mixes with 90 per cent. alcohol without turbidity or formation of water drops on the surface. The little cloudiness produced by breathing on the latter, should at once disappear. Aniline colors ought not to fade perceptibly in bergamot oil even after forty-eight hours; while celloidin ought not to be softened by it in the least; on the contrary, sections that have been softened by strong alcohol should acquire greater firmness in bergamot oil.

Tracing paper must first be cut into strips about as broad as the object-carrier, and at least three times as long as the cover-glass. The shape of the latter is marked on one end of the strips. The paper must be perfectly smooth, well oiled and transparent, and unite some stiffness with flexibility. The strip should be held by its free third, horizontally, in the oil, supported from beneath by the middle and third fingers, and held from above by the thumb and first finger, so that a slight longitudinal and upwardly directed concavity can be given to it. Thus the immersed end of the paper, on which the sections are to be arranged, can easily bear a slight weight without bending. Now, while the left hand holds the strip of paper over the surface of the oil, the right draws the sledge of the microtome with the little finger, and also turns the micrometer screw. Between the middle and third fingers of the same hand, a fine elastic brush is held, supported by the ball of the thumb, and between the first and middle fingers and the thumb a very sharp but strong dissecting needle. The section is removed from the knife, where it lies in plenty of 95 per cent. alcohol, with the brush, and put on the oil; here it is followed with the strip of paper held beneath and guided near the position where it should lie; then drawn with the needle out of the oil on to the paper. The sections are arranged in cross rows, which are held from 2 to 3 mm. out of the oil to prevent them from swimming away. The rest of the paper remains in the oil and is only withdrawn as it is covered with sections. When the desired number of sections has been brought into order on the paper, the oil is drained off, and the paper is then turned so that the sections face downwards. In this position the strip is allowed to fall slowly on the object-glass. Then it is flattened out with a dissecting needle and dried with blotting-paper. Now the tracing-paper, through which the whole series can plainly be seen, must be carefully removed, leaving the sections on the object-glass. If any sections should remain on the paper, the latter, after the sections in question have been moistened with oil, is replaced in its former position on the object-glass, pressed a little, and then removed, or if the sections are quite dry they may be taken with pincers and transferred to the object-glass.

As soon as all the sections are in order on the object-glass, the smooth surface of the blotting-paper is laid on it and stroked lightly several times with the finger to remove all the superfluous oil.

The Canada balsam and cover-glass maynow be added without danger of displacing the sections. Entire removal of the oil insures the preservation of the most fugitive colors. The sections should not be placed near the edge of the cover-glass, as every discoloration begins at the edge.

In the foregoing manner, over 100 sections were placed in a complete series under one cover-glass, in as short a time as by the paraffin method.

As celloidin, like paraffin, does not readily penetrate chitinous envelopes, cuticula and cocoons, care should be taken:—

1. To use at first very thin solutions, which should be gradually brought to the concentration which the imbedding mass is to have

2. To imbed twice, the first time merely to cut the object in pieces, or open a cocoon, or cut etc., with the microtome.

SCIENTIFIC NEWS.

—The American Association for the Advancement of Science will hold its thirty-seventh meeting at Cleveland, commencing August 21st, under the Presidency of the Hon. J. W. Powell, of Washington, D. C.

—The International Geological Congress will hold its fourth meeting in London, commencing September 14th. The honorary president is Professor T. H. Huxley, who is also president of the organizing committee. The Acting president is Professor J. Prestwitch.

—The British Association for the Advancement of Science holds its annual meeting at Bath this year, commencing September 5th. The President is Sir Frederick J. Bramwell.

—The Annual Excursion of the Geological Society of France will be this year in the neighborhoods of Commentry, Chateauneufe St. Germain des Fossés, Moulin and St. Armand. A great range of geological formations will be visited.

—Professor Charles Linden, of the Buffalo High School, died in Buffalo, N. Y., February 3d, 1888, aged fifty-six years. He was born in Breslau, Germany, and came to this country at an early age. His studies were in the line of ornithology, and he made collecting expeditions to Florida, Brazil, the West Indies, and Labrador.

—An obituary notice of the late Professor F. V. Hayden, from the pen of Professor J. P. Lesley, occurs in the *Proceedings* of the American Philosophical Society, Vol. XXV.

—The first part of the eleventh volume of the *Journal of the Cincinnati Society* of Natural History contains a general index to the previous ten volumes.

—The annual report of the Essex Institute (Salem, Mass.) shows that society in a prosperous condition. The additions to the library for the year aggregate 20,739 entries, while the income for the year, exclusive of legacies and special funds, amounted to $4,405.

—A new zoological station is to be started at Ostend. It will be supported by four Belgian universities.

—The Linnean Society of London celebrated its hundredth anniversary May 24th, 1888. Among other features of the centennial were the reading of a eulogium upon Linnæus, prepared by his successor, Professor Fries, of Upsala; one by Sir Joseph Hooker, upon Robert Browne; one by Professor Flower, upon Charles Darwin, and one by Professor P. W. T. Thistleton Dyer, upon George Bentham. The council has decided to establish a Linnean gold medal, to be awarded to a botanist and a zoologist in alternate years, and the first award was made to Richard Owen and Sir Joseph Hooker.

—The meeting of the British Association for the Advancement of Science will be held this year at Bath, beginning September 5th at 8 P.M.

—J. Jverson has been sent by the University of Christiania to Sumatra to make zoological collections for the University.

—The first and second parts of the monograph of the weaver-birds (Ploceidæ) and arboreal and terrestrial finches (Fringillidæ), by Edward Bartlett, The Museum, Maidstone, Kent, England, is now ready for circulation. Price, 10*s.* 6*d.* each part.

—Willard A. Stowell, 222 Second st., Trenton, N. J., is preparing a catalogue of all North American Ferns, embracing in that area Mexico, Central America and the West Indies. He desires notes and exchanges.

—Professor Harrison E. Webster, of Rochester University, has recently been elected President of Union College, Schenectady, N. Y.

—The Association of German Naturalists and Physicians holds its

annual meeting this year at Cologne, beginning on September 18th and continuing until the 23d.

—Flower's Osetology of the Mammalia has been translated into the German by Dr. Hans Gadow.

—For over fifty years Karl Ernst von Baer's "Über Entwicklungsgeschichte der Thiere" has remained incomplete. At last, Dr. L. Stieder, of Königsberg, has issued the fourth (last) part from von Baer's own manuscript.

—Dr. Fridtjof Nansen, curator of the Bergens (Norway) Museum, goes this summer to Greenland, and expects to cross the country on sledges and snow-shoes.

—During the absence of Dr. Stuhlmann in Zanzibar, Dr. A. Schuberg occupies the position of assistant in the Zoological-zootomical Institute at Würzburg.

—Dr. P. P. C. Hoek, of Leiden, well known for his many morphological investigations, has been appointed to the scientific directorship of the Dutch Fisheries Commission.

—Dr. Ephraim George Squier, the well-known archæologist, died in Brooklyn, N. Y., April 17, 1888. He was born in Bethlehem, N. Y., in 1821, graduated at Princeton in 1848. His first work of note was the investigation, in company with Dr. E. H. Davis, of the mounds of the Mississippi Valley, the results of which formed the first volume of the Smithsonian "Contributions to Knowledge." Other works in the same line were his "Ancient Monuments of the West" and his "Aboriginal Monuments of New York." Later he was sent on government service to Central America, which resulted in several works on the ethnology and antiquities of that region. In 1863 he visited Peru, but his account of his investigations in that region was cut short in the middle of its publication by a mental disorder, which left him for the last seventeen years of his life utterly incapacitated for work.

—Henry James Storin Pryer, a well-known entomologist, died in Yokohama, February 17, 1888. Since 1871 he has resided in China and Japan, and at his death had in press an extensive work upon the butterflies of Japan, with English and Japanese text.

—The Pennsylvania Forestry Association appeals to Congress against the wide and wanton destruction of the forests. . . . Of the two bills now pending in Congress, No. 6045 provides a remedy for the mischief, and is greatly preferable to No. 7901. The for-

mer bill provides for the careful selection of proper lands for permannet forests, to be guarded from spoliation and destruction, and for the advantageous sale of merchantable timber under Government supervision, and with constant regard to the preservation of new growths. The bill also makes unauthorized cutting and injury a criminal offence, and establishes a system of guardianship and enforcement of the laws against individuals and corporations. The bill No. 7901 is much more loosely drawn as to protection from waste and injury, and lacks definite and strict methods of enforcing the law.

—Professor Joshua Lindahl, of Rock Island, has been appointed by the Governor of Illinois to the position of Curator of the State Museum at Springfield, in place of the late Professor A. H. Worthen.

—THE ZOOLOGICAL SOCIETY OF PHILADELPHIA is about to break ground for extensive additions to the reptile house. They are going to build two wings each thirty-two by twenty-eight feet, which will be simply conservatories. In one of these the tree-climbing snakes and lizards will be seen in the natural slate and among plants and shrubs as under natural conditions.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

BIOLOGICAL SOCIETY OF WASHINGTON. — May 19, 1888. — The following communications were read: Mr. F. W. True, "The Hawaiian Bat;" Mr. Wm. T. Hornaday, "Man-Eating Crocodiles;" Dr. C. Hart Merriam, "A Revision of the Dipodidæ;" Mr. F. A. Lucas, "The Affinities of Chamæa."

June 2, 1888. — At the last meeting of the season the following papers were read: Mr. F. H. Knowlton, "Notes on the Fossil Wood of the Yellowstone Natural Park;" Mr. W. B. Alwood, "Notes on the Artificial Pollenation of Wheat;" Mr. F. A. Lucas, "Abnormalities in the Ribs of Birds."

PHILOSOPHICAL SOCIETY OF WASHINGTON, Saturday Evening May 26th, 1888.—The following communications were read: Mr. Robert T. Edes, "The Sphygmograph;" Mr. H. A. Hazen, "The Recent Mount Vernon (Ill.) Tornado;" Mr. Merwin-Marie Snell, "Observations on Certain Hypnotic Experiments of the Comte de Maricourt;" Professor E. D. Cope, "The Relation of Consciousness to Animal Motion."

Boston Society of Natural History. — May 16, 1888. — Professor Alpheus Hyatt read a paper on "The Evolution of the Faunas in the Lower Lias." Professor W. O. Crosby gave an account of the Geology of Nantasket.

Philadelphia Academy Natural Sciences.—November 15, 1887.—Prof. J. A. Ryder spoke of an improved method of preparing sections of animal tissue for microscopic examination. The object is first hardened as usual, then soaked in a solution of celloidin twenty-four hours, then in chloroform until the celloidin is transparent. It is afterward subjected to the action of paraffine before cutting. The use of celloidin enables the operator to make continuous thin sections of the most fragile structure without breaking.

Prof. Heilprin contravened Mr. Boulenger's criticism of his (Prof. Heilprin's) statement regarding the distribution of North American Lizards. He had defined a line drawn from San Francisco to Galveston as the southern boundary of the North American Lizard fauna, while Mr. Boulenger held that the North American fauna was a mere offshoot from that of the southern continent. The genera Sceloporus, Phrynosoma, Eumeces, and Ophisaurus, referred by Mr. Boulenger to the South American fauna were by Prof. Heilprin maintained to be North American with considerable distribution in the transition region.

Dr. Leidy called attention to a fragment of metamorphic limestone from Eldorado county, California, bearing on its surface a spot of native gold, and stated that it was the first example he had seen of gold occurring in limestone.

Descriptions of two new species of fishes from South America by Prof. D. S. Jordan, were presented for publication November 22d.

Dr. H. Allen called attention to the rugæ or ridges upon the palate. He proposed to name them the sutural, pre-sutural, and post-sutural folds. He had found certain peculiarities in man which served to distinguish the left side from the right.

The Rev. Dr. McCook described a spider from Florida. The web of this species was distinguished from that of other orb-weavers by having as many as fourteen cocoons, strung in the axis of the upper radius, and connected along one side by thick white threads. He named the species *Cyrtophora bifurca.* Dr. McCook also referred to a communication received Mr. C. Townsend, describing the nests of a white ant found in Honduras. Wood pulp seems to be the material used, and the nests are placed between branches of trees.

December 6, 1887.—Mr. Binder exhibited, among other fine minerals added to the Vaux collection, a specimen of Hiddenite, a mineral which from its rarity, is at present more valuable than the diamond.

Mr. Meehan called attention to the tubers of *Dioscorea eburnea,*

of China. The yield of tubers seemed to be very large, but they were intensely bitter.

December 13, 1887.—Dr. Leidy, in speaking of the presence of parasites in fish, mentioned the fact that the drum fish (*Pogonias chromis*) seemed in some cases to owe its flavor to a parasitic worm, *Acanthorhynchus reptans*. He also mentioned the occurrence of the larvæ of bot flies in terrapins.

December 20, 1887.—Prof. Heilprin discussed the rate of formation of deep sea deposits, and concluded that there were probably unknown factors that involved deposition in past ages at a greater rate than at present. Dr. Dolley remarked that in the Bahamas foraminiferal deposit was comparatively rapid; some of the smaller bays are being filled up by such material. He also spoke of what are called by the natives "banana holes," small pits with a deposit of soil and red earth, which may have been formed by the solution of the lime by the carbonic acid of vegetable matter.

January 10, 1888.—Dr. Leidy described the cranium of a puma recently found under about thirty feet of earth in the bed of the Kaskaskia river, Illinois. It differed from the cranium of recent animals in having a higher inter-parietal crest, a narrower outline, and a flatter forehead.

January 24, 1888.—Prof. W. P. Wilson stated that the appliances for capturing insects were much more efficient in *Sarracenia variolaris* than in the more common *S. purpurea*. He drew the conclusion that in *S. purpurea* the insect-feeding habit was disappearing.

Dr. Horn exhibited a collection of May beetles, including seventy-nine out of the eighty-one species known from North America north of Mexico, and containing three specimens of the very rare *Pleocoma*.

Prof. J. A. Ryder explained the law governing the cleavage of the yoke masses in the eggs of lampreys, frogs, and salamanders, and showed that, contrary to the dictum of Hertwig, it differed from that of the osseous fishes, birds and reptiles.

January 31, 1888.—Prof. Heilprin communicated the results of his studies of the geology of Nantucket, in 1886. The beds at Sankotty had yielded about fifty-five species of fossil mollusks. These beds had hitherto been described as post-pliocene, and the species identified with existing forms. The speaker had found a distinct species of Neptunea, besides minor differences in other forms. This proved that these beds are not so recent as has been supposed, and the disposition of the strata indicates a pre-glacial date.

Prof. W. J. Brooks gave the life-history of a jelly-fish, the mode of reproduction of which showed some peculiarities. All asexual forms hitherto known are only capable of reproducing forms like themselves, starting their offspring at the point at which they themselves started. This medusa, however, bears reproductive organs on tubes radiating from the stomach.

Prof. Wilson stated that the so-called sprouts or corky roots of

the black mangrove were largely composed of a peculiar tissue formed of large air cells, and that their function is the aeration of the plant.

Prof. Rothrock spoke of mimicry in plants, and gave as examples the alga-like outgrowth from the spores of mosses, the external resemblances of Zygadenus,and Swertia,and between *Nepeta glechoma*, and *Lamium amplexicaule*.

Dr. Dolley reported the occurrence of a large parasitic Ascaris in *Carcharias ceruleus* (the sand shark).

February 21, 1888.—Dr. Leidy described specimens of a small crustacean (*Cirolana*) found swarming in the bodies of edible crabs.

February 28, 1888.—Prof. H. C. Lewis exhibited a fragment of a meteorite containing diamonds.

Dr. Sharp described specimens of jelly-fish found in a fresh-water pond at Nantucket.

March 6, 1888.—Dr. Sharp spoke of the classification of lamellibranch molluscs and traced them from a central type such as Arca. He considered that the lamellibranchs had degenerated from the gastropods.

March 20, 1888.—Dr. Leidy called the attention of the Academy to numerous specimens of a minute parasitic crustacean from the gills of *Roccus lineatus*. They live suspended on the outer surface of the red gills of the bass. The species is the *Ergasilus labricis* of Kroyer, but is not mentioned in Rathbun's published list of parasitic Crustacea. The same fish frequently bears examples of the worm *Echinorhynchus proteus* in its intestines.

April 3, 1888.—Prof. Heilprin called attention to a human footprint in a slab of volcanic tufa from Lake Managua, Nicaragua. This footprint had been overlaid by a deposit of more than twenty feet in thickness, and the bones of the mastodon were said to have been found in the same deposits. The evidence to be drawn from the shells accompanying the footprint was not considered by the speaker as proving any very great antiquity.

April 17, 1888.—Mr. Meehan spoke of *Shortia galacifolia*, a rare North American plant, of which several thousand examples have been found in the mountains of North Carolina.

Dr. Koenig described a specimen of eleonorite from Sevier county, Arkansas. It occurs in cavities of dufrenite, and is of a blood-red color. The only specimens of the mineral heretofore known have been from the Eleonore mine, near Giessen, Germany.

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MEGALITHIC MONUMENTS OF BRITTANY.

BY THOMAS WILSON.

THE term megalithic has been recognized in France as applying to the unhewn stone monuments erected by man in prehistoric ages.

The ancient province of Brittany consisted of the area comprising the present five departments in the northwest corner of France: Finistère, Côtes du Nord, Ille et Vilaine, Morbihan, and Loire Inférièure. This province is exceedingly rich in megalithic monuments—in some respects it is the richest in the world.

The man of the paleolithic period does not seem to have occupied this part of France. In only two places have any of his implements or utensils been found, and these are on the extreme eastern edge of the province. However, that is of little moment in the present discussion, for the prehistoric man of that age having made no monuments, left none.

The occupation of Brittany by prehistoric man began in the Neolithic age or age of polished stone called by M. de Mortillet Robenhausen, after the station of that name in Lake Pfaffikon, near Zurich, Switzerland. This was in the present geologic epoch and the man is supposed to be of our day.

He is supposed to have come to this country from a more or less remote east and to have wrought a revolution in the civilization of the paleolithic man who had preceded him. He brought with him a knowledge of agriculture and of grazing. He was not nomadic. He had a government or some sort of organized society. He had

not the art of the former epoch, enabling him to represent by engraving or sculpture the living things he must have seen; his art was confined to the ornamentation of his dress and the decoration by lines and dots in geometric patterns of the pottery, and afterwards the bronze, objects which he used. He was capable of long-continued plodding labor and performed herculean tasks in the construction and erection of his monuments. He had a religion: he buried his dead, depositing some of his choicest valuables in the grave with them and erecting over them monuments of the grandest and most expensive character; these have endured until the present time, and are now being bought, restored, and preserved by the state.

The names given to megalithic monuments as adopted in France are taken principally from the Breton language.

Men means a large stone.

Hir means on end.

Menhir means a large stone standing on end.

Dol means table.

Dolmen means a table of stone.

Lech means a smaller stone.

Cromlech means a circle of stone. It also has a higher signification, that of eternity, such as is symbolized by our circlet of gold, or the snake in that form, swallowing its tail.

Alignment and tumulus are modern French words, and mean, the first, lines of menhirs; the second, a mound of earth or stones usually covering a dolmen.

The megalithic monuments of France are under the supervision of a governmental commission appointed by the minister of fine arts; of this commission Henri Martin, the historian, was, until his death, and Gabriel de Mortillet now is, the chief.

The commission has authority to purchase, subject to approval, such monuments as it may deem worthy of conservation, and when purchased, they may be restored to their original condition and properly preserved. A certain sum of money is appropriated for the use of this commission. The members serve practically without compensation. The action of the French Government in this regard is in the highest degree commendable. The Anthropologists' Society of the United States might well urge upon the Gov-

ernment the adoption of similar measures for the protection of American Indian mounds and other ancient monuments against the destruction with which they are threatened.

The French commission has published a list of the megalithic monuments of France. The total number was put down at about 6,300; of these 1,600 (increased by later discoveries to nearly 2,000), are in Brittany.

They are thus classified and distributed:

Province.	Dolmens.	Menhirs.	Alignments.	Cromlechs.	Polishing stones.	Basins.	Rocking stones.	Divers.
Loire Inférieure...	50	57	1	2	....	6	1	10
Morbihan............	305	295	8	19	1	37	5	14
Finistère..............	170	222	9	3	....	1	3	5
Côtes du Nord.....	112	133	....	9	....	....	13	2
Ille et Vilaine......	15	32	5	9	....	1	....	1
	652	739	23	42	1	45	22	32

This table would misrepresent the work of the prehistoric men of this country unless explained. While a dolmen and a cromlech count as separate monuments, each may require from ten to fifty immense stones, and each of these may be a monument in itself. So also with a menhir and an alignment—an alignment consists of many menhirs.

I will only attempt to describe the general types of megalithic monuments, though it would be necessary to exceed this to convey an adequate idea of the extent and grandeur of the monuments as a whole.

The dolmen was made in the form of a chamber or series of communicating chambers or alley-ways with sides, floor, and covers,

and was a tomb. Its floor and entrance were at about the level of the neighboring surface, and the entire monument is believed to have been covered with earth; thus in ancient times it was a tumulus.

The menhir is a single stone planted on the earth and standing erect.

The cromlech is a greater or less number of menhirs arranged in form of a circle or a square.

The alignment is the same as the cromlech; only the menhirs are arranged in nearly parallel lines.

All of these monuments consist of large unhewn granite stones. The smallest of the stones used we estimated to weigh a ton. Some, indeed many, have been accurately calculated upon the known basis of 2,700 grams for one decimetre cube, or say two tons avoirdupois for a cubic yard.

The covering stones of a dolmen have been found to weigh five, ten, twenty, and forty tons. The alignment menhirs weigh from

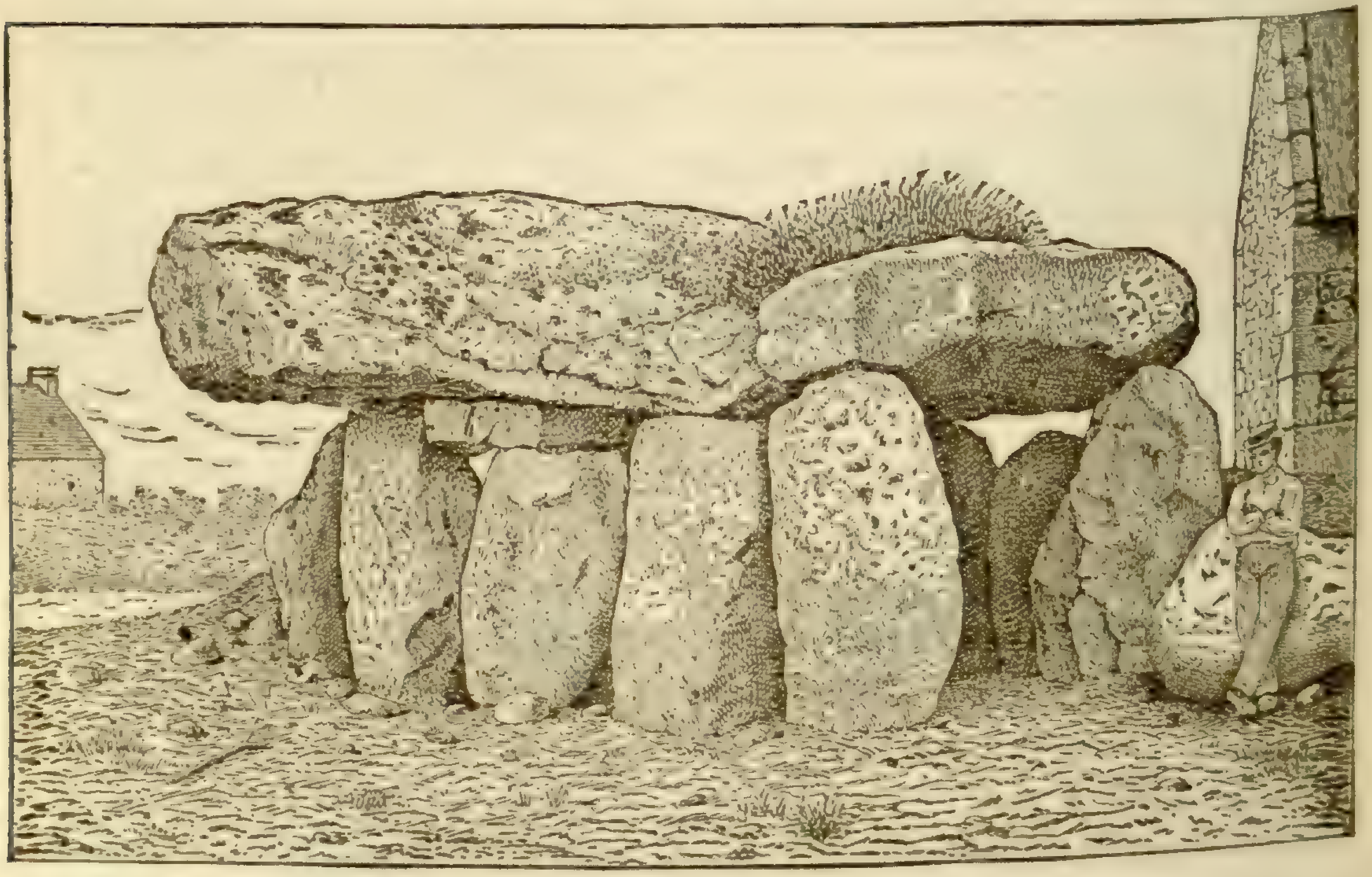


FIG. 1.—Dolmen of Crucuno.

thirty to sixty tons: two near Plouharnel weigh respectively eighty-three and ninety-six tons, the former that of Sainte Barbe and the latter that of Erdeven.

DOLMENS.

There are in the department of Moribihan about 400 dolmens, some in ruins, but many well preserved. Used for sepulture they may be described as houses for the dead. They are perhaps the earliest form of receptacle for the dead, although the Kistvaen, made of smaller flat stones with sides, ends, top and bottom shaped like a box or chest (Kist) and covered with stones like a cairn, may be older, but they may also have only been the sepultures of a poorer people.

The dolmen of Crucuno is most frequently shown to the visitor. It is easy of access, is on the road from Plouharnel Carnac to Erdeven. It is large, in good condition and presents a fine appearance. It was used as a stable before being purchased by the government. Its form, size, and condition make it a good representative dolmen.

FIG. 2.—Dolmen of Lochmariaker.

The dolmen of Lochmariaker is situated near the village of that name overlooking the Gulf of Morbihan at its opening into the sea. Lochmariaker has many evidences of Roman occupation. It was on this gulf, and probably within sight of this spot, where

took place the great sea fight between Cæsar and the Venites. It has but a single covering stone bearing the form and worn appearance of a huge boulder. I do not know its exact size, but as I remember it it is twenty to twenty-five feet in length, nine or ten feet in breadth, and two or two and one-half feet thick. The chamber is rectangular, somewhat smaller than the dimensions of the covering stone above given, and is six or seven feet in depth. The bottom of the covering stone, plainly to be seen from the interior by looking upwards, is decorated with the representation of an immense polished stone hatchet or celt, with a long handle terminating in a knob. The instrument is represented in outline by a groove which has been cut, or rather pecked, into the granite surface.

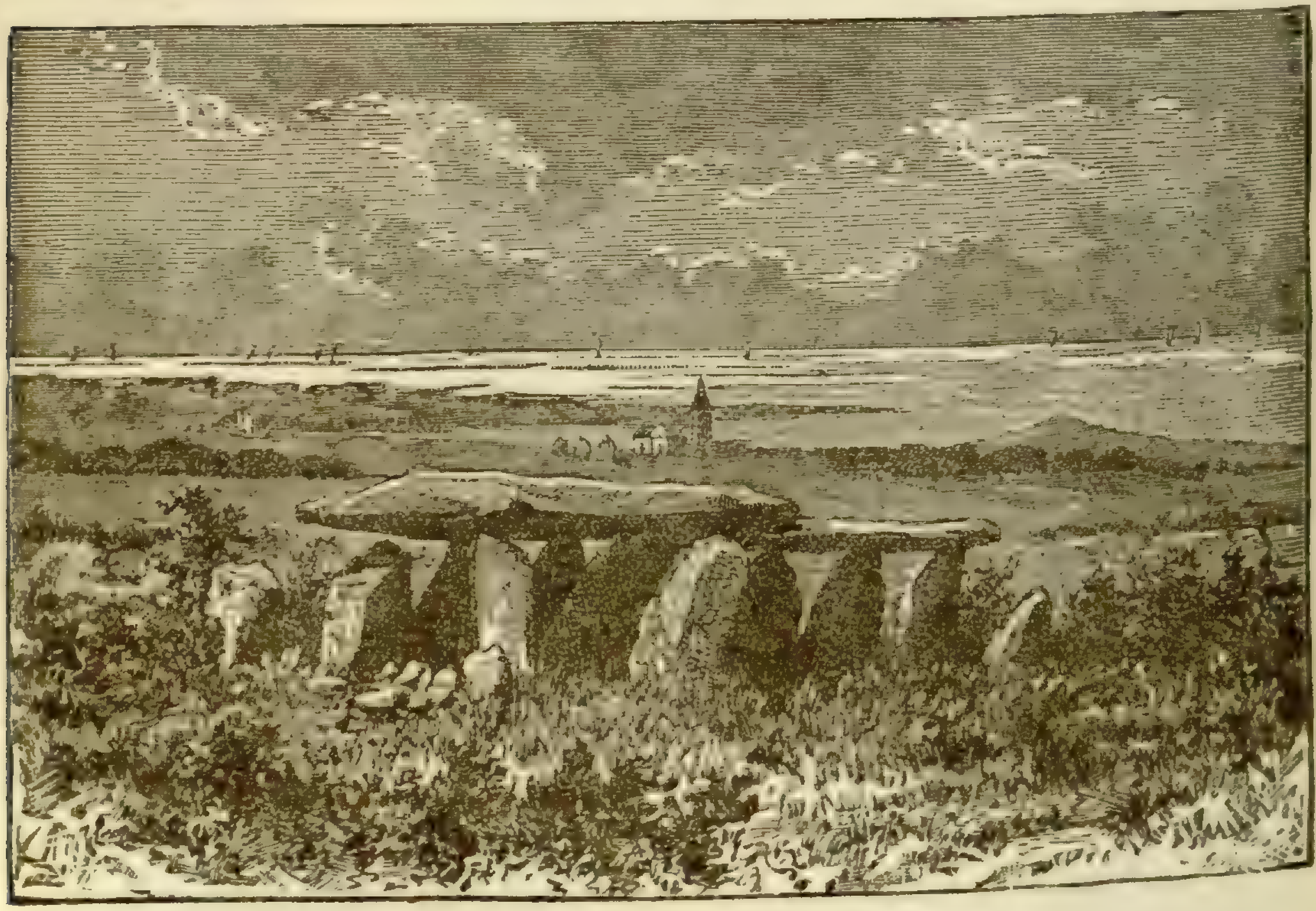


FIG. 3.—Dolmen of Grand Island. Another form.

The dolmens, usually square but sometimes round, were made in the form of chambers, sometimes as small as four by six feet, four feet high; sometimes these were sixteen feet wide, thirty feet long, and eight feet high. Most of the dolmens consist of a single chamber, but many have as many as six lateral chambers. They are made of huge flat unhewn granite stones, which are stood on end or edge to form the sides and ends of the chambers. The

covering stones (which are called tables) are large, and a single one is sometimes sufficient to cover the entire monument.

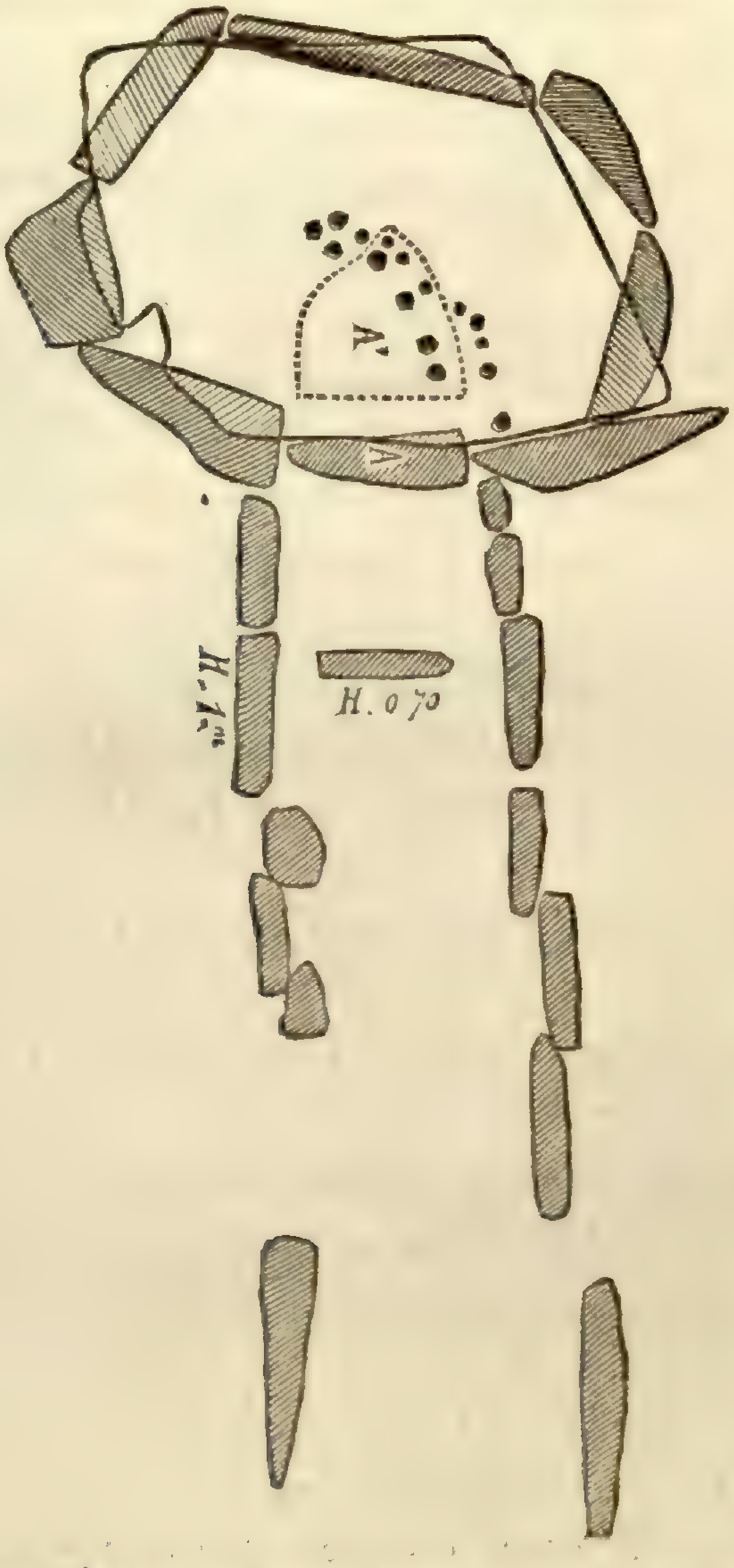


Fig. 4.—Ground plan of a single chambered dolmen, showing the stones on edge forming the gallery, chamber, and door. The light line around shows the covering stone with a group of cup markings on the under side.

The dolmens usually have a gallery or corridor leading to the chamber, made in the same way. This is for approach to the chamber. This gallery is about three or four feet wide and as many or more high, sufficient for a man to make easy entrance. It is sometimes blocked with another slab of granite at the inside and nearest the chamber, sometimes at the outside, and sometimes both. Fig. 4 will explain this. In this example the door has fallen in.

Their orientation is irregular. They open in every direction,

north and south, east and west; but there are more to the south than to the north, and more to the east than to the west. The greater number open towards the southeast. I exhibit for purposes of comparison the ground plan of several of the important dolmens (Fig. 5). It will be perceived that though they are all one general type, yet no particular or precise form has been invariably followed in their construction. Each one has its own individuality and differs from every other.

The fine, unshaded lines indicate the covering stones. The direction of the opening is indicated by letters SSE, etc., etc.

1. Dolmen of Kerlescant—at Carnac. This opens to the west. This dolmen is what is usually denominated *Allee couverte.*

2. Dolmen of Kervilor, at Trinite-sur-Mer. Opening to s. s. e., one side square and one side round.

3. Dolmen du Rocher at Plougoumelen. Opening to s. s. e.

4. Dolmen of Crucuno—same as Fig. 1. Opening s. e., chamber rectangular.

5. Dolmen of Keroed-Kerzu, at Crach. Opening east, circular chamber.

6. Dolmen of Ben-er-Groah at Lochmariaker. Opening south, two successive, circular chambers.

7. Dolmen of Kervihan, Carnac. Two chambers, semi-circular with alley between. Opening s. s. e.

8. Dolmen of Keriaval, near Plouharnel-Carnac. Three lateral chambers—opening east.

9. Second dolmen of Mane Kerioned, near Plouharnel. This is one of three in the same tumulus—side by side—opening south, and is elaborately sculptured on the face of the supports.

10. Three dolmens of Rondessec at Plouharnel, all under the same tumulus, opening s. s. e. In one of these was found a pair of gold bracelets, one of which is still to be seen at Pere Gaillard's Plouharnel.

11. Small type dolmen of Kermario, Carnac. Opening south-east.

12. Dolmen of Mane Lud, at Lochmariaker. Opening south.

13. Dolmen (with tumulus) of Kercado, Plouharnel. s. s. e.

14. Tumulus of Pornic, Loire-Inferieure, in the upper right hand corner. This contains several dolmens opening in different directions.

PLATE XI.

FIG. 5.—Ground plan of Dolmens in Brittany.

A opens to the east.

B and C to the south-west.

D to the north.

E and F in ruins.

It is believed that the interments were made continuously in the same sepulture (as is done partially in our own vaults), a practice which prevails to a certain extent in the country to the present day. When the dolmen (or tomb) became full, the skeletons could have been taken out and deposited in an ossuary. We found evidence of this at the dolmen of Port Blanc. It has been contended with great probability that the bodies were buried elsewhere at first and then after they had become dessicated or the flesh had been removed from the skeletons, that the bones were placed within the dolmen. M. Cartailhac has elaborated this theory with much ability. A fete day, like All Saint's, was perhaps selected for the purpose, and the dolmen may have been opened and all bones deposited therein with due ceremony. In support of this view it is argued that the skeletons have been found in unnatural and impossible positions in the dolmens; that they have been found colored or painted, which could only have been done after the denudation of the flesh, and that sometimes the entrance to the dolmen is by means of a hole cut in the stone door, so small, from sixteen to twenty inches round or oval, that the entry of a corpse would be difficult, if not impossible.

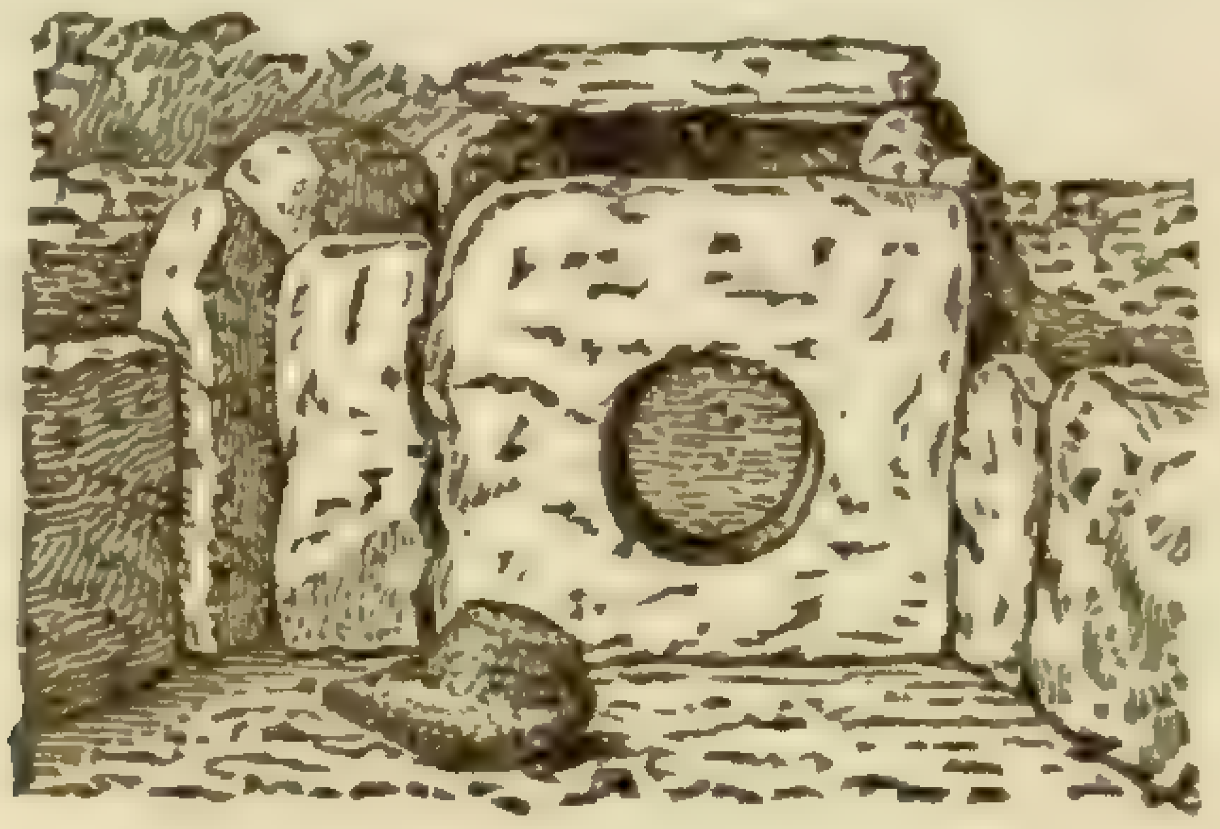


FIG. 6.—Circular hole being the entrance to a dolmen, from the department Sune-et-Oise, now removed to and exhibited at the Musee St. Germain, Paris. The round cover being in the foreground.

Excavations and searches were conducted by myself in company with the local archæologists, M M. Gaillard, Fornier, Cappe, Rialan and the Abbe Luco. I subjoin a list of some of the larger stones in the more important dolmens, with sizes and weights.

Dolmen of Crucuno: Property of the government; the covering stones seventeen feet long, ten and a half feet wide, 30.3 inches thick; weight forty-one tons of 2240 pounds (Fig. 1.)

Second dolmen of Rondessec: Property of the government; has two covering stones both about the same size and weight, 11.6 feet long, seven feet wide, twenty-eight inches thick; has eighty square feet of surface, 198 cubic feet, and weighs fourteen and one-half tons.

First dolmen of Mane Kerioned: Property of the government; has thirteen supporting and four covering stones, one of which weighs about ten tons. Its chamber and gallery are twenty-eight feet long.

Second dolmen of Mane Kerioned: Has twenty-four supporting and four covering stones, one of which weighs seventeen tons. Its chamber and gallery are thirty-four feet in length. This dolmen has extensive sculpturing on the supporting stones forming the sides and ends.

Dolmen of Mane Groch: Property of the government; has a corridor, large central chamber and three side chambers, it has twenty-three supports and seven covering stones.

Dolmen of La Madeline: Has five supports and two table or covering stones.

First dolmen of Mane Bras: Has thirteen supports and two table or covering stones, and weighs ten tons.

Second dolmen of Mane Bras: Has nineteen supports and two tables, and weighs ten tons.

Dolmen of Kergaval: Has six supports and one table and weighs twenty tons.

It was once the fashion to speak of these monuments as having belonged to the Druids. This seems to be a tradition that has grown up within historic times and long after the Druids had passed away. The dolmens belonged as well to the age of bronze as to that of polished stone. Incineration and inhumation were both customary, but the former method pertains more to the bronze age.

There are about 3,500 dolmens in France. They are plentiful in the centre, south, and west, but rarer in the north and east; plentiful in Great Britain and Ireland, in Spain and Portugal, in

Denmark and Sweden; some in Belgium and Holland, the Rhine country, and Western Germany; none in Norway; almost none in Italy; none in Eastern Europe. The city of Dresden marks about the dividing longitudinal line.

They are found on the coast of Northern Africa, between Morocco and Tripoli; in Palestine, in Asia, in South and Central America, but not in North America.

TUMULI.

Many of the dolmens are now covered with earth, and these have been called tumuli. It is believed by those best qualified to judge, after the longest experience and closest examination, that all have at one time been so covered. One reason for this belief is, that it is universal to find the gallery, corridor or covered way, made of the same kind of stones in the same way, on the same level nd leading from the principal chamber, gradually narrowing in

FIG. 4.—Section of a tumulus showing the dolmen with its corridor or alley-way and means of second interments.

both width and height to what would appear to have been the circumference of the tumulus. In this regard the dolmen now without a tumulus corresponds exactly with those covered by one. Some of these corridors are forty and fifty feet in length. In this way, the tomb could be covered, the monument completed and yet

the entrance be easily opened and entered upon the occasion of a second or subsequent interment.

The covering of these tumuli consists of layers of broken granite alternated with layers of clay and mud from the seashore and vegetable earth from the neighboring surface.

The tumulus of Gav'r Inis has a dolmen remarkable for the sculpturings. It is eight feet by seven, five feet eight inches high, with a corridor or alley fourteen feet long, four feet six inches wide; five feet four inches high, while the tumulus crowning it is 180 feet in diameter and was thirty feet high.

Tumiac at Arzon is 100 feet in diameter and sixty-five feet high; Manerhoeck Lochmariqueris 300 feet in diameter and thirty feet

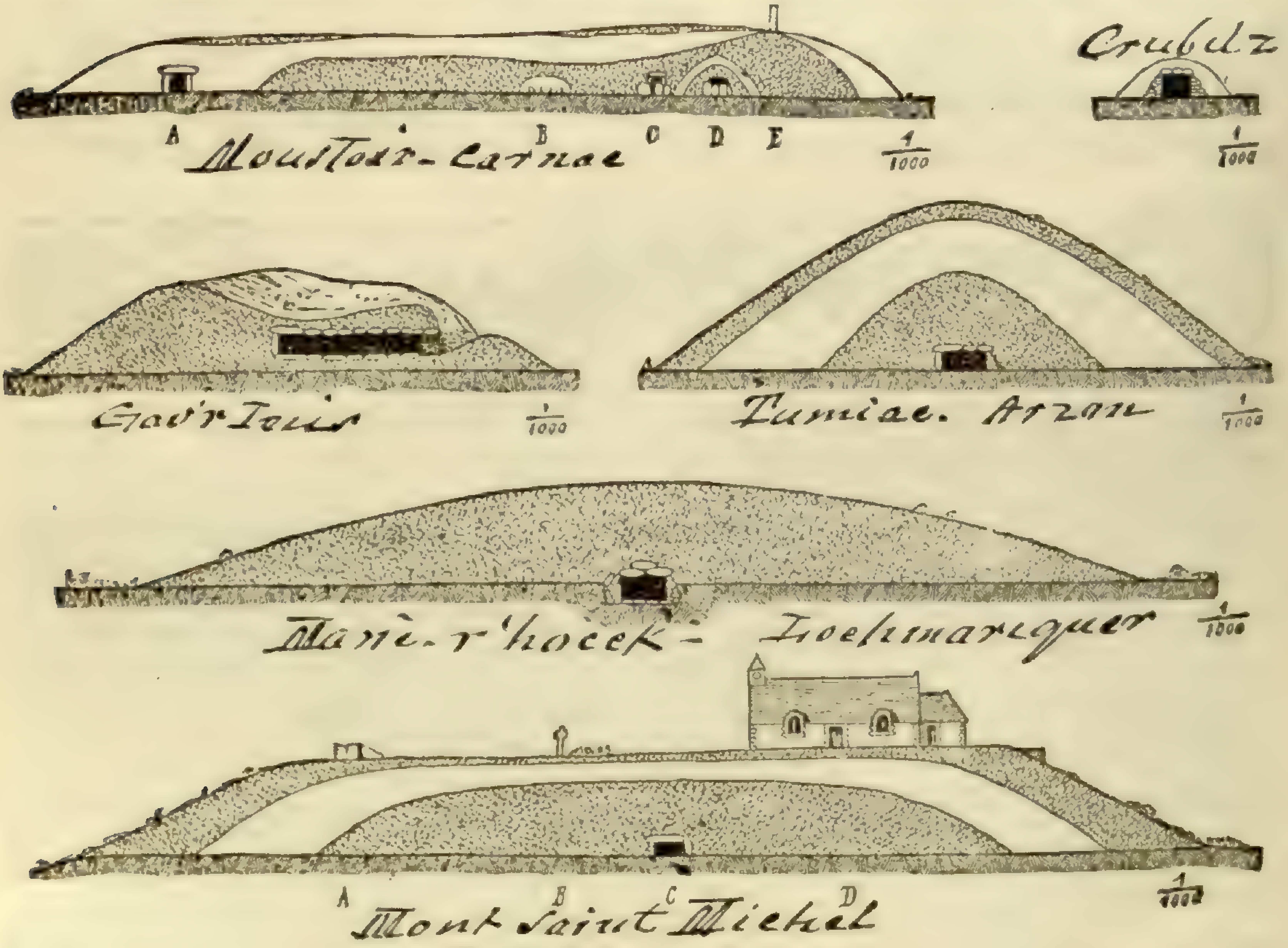


FIG. 8.—Tumuli in Brittany.

high; Mane Lud 300 feet long, 150 wide and thirty feet high; Mount Saint Michel 320 feet long, 120 feet wide and eighty high; Kercado is about 100 feet in diameter and twenty feet high.

MENHIRS.

The dimensions of some of the menhirs is as follows:

Penmarch, twenty-five feet high; Cadiou, twenty-eight; Mount

Dol, thirty-one; Plouarzel, thirty-six and one-half; Plesidy, thirty-seven; and Lochmariquer, sixty-seven and one-half. The latter, fallen and broken, is thirteen and one-half feet wide and seven

Menhir of Caclion — of Penmarck

FIG. 9.

and one-half feet thick and weighs 347 tons. There are 739 of these in Brittany. The menhir stands single and alone. When arranged in parallel lines as they sometimes are, they are called alignments.

ALIGNMENTS.

The Province of Brittany has twenty-three alignments—one-half of those in all France. The department of Morbihan and Finistère have, together, seventeen of these. Carnac has in its immediate neighborhood six out of these seventeen. These six alignments represent 3,000 menhirs.

Menec, near Carnac, has 835 menhirs, arranged in eleven parallel lines, 3,778 feet in length and 328 feet in breadth at the head,

tapering to 200 feet at the tail. It has at its head a cromlech of sixty-two menhirs.

Kermario has 678 menhirs, no cromlech, nine parallel lines, 4,037 feet in length—same width as Menec.

Kerlescant has 258 menhirs, a cromlech square of thirty-nine menhirs, thirteen lines, 1,000 feet in length—393 feet width at the head and 164 at the tail.

Erdeven has thirteen lines, 1,120 menhirs, 6,886 feet in length, 836 in width at the head and 180 at the tail.

FIG. 10.—Alignment of Menec.

About one-half of these have been overthrown and are lying on the ground. About ten per cent. should be added for all the menhirs known to have been destroyed in modern or historic times. Without doubt the gaps now existing were once filled. This would double, at least, the number. These monuments have served as stone quarries for the neighborhood, and doubtless the great castles and churches of the early ages were built therefrom. The light house at Belle Isle was built of the granite menhirs of the alignment of Erdeven.

Thus they stand, dotting the country in every direction, enormous,

rough, rude, unhewn granite stones—great in their mightiness, mysterious in their solitude, belonging to another civilization mighty in its time, but now dead and buried in the ages of the past. They have no inscriptions, and no history. We know them to have been the work of man, and that is about all. In the case of menhirs, they rear their heads like great giants. In the alignments they stand in close array with serried parallel lines, and stretch across the level country miles away, their bodies gnawed and their heads scarred and seamed by the tooth of time since the distant ages when they were erected. It is their size, their simplicity, their number, their repetition, as well as their antiquity, which render them so imposing and so impressive. No words can convey to our mind an adequate idea of this impressiveness. They must be seen to be appreciated.

A word as to the age of these alignments.

The menhirs, whether standing or fallen, are frequently used as fences, the interstices being filled usually with an earthern embankment. In the headline, at the alignment of Erdeven, many had fallen and were thus covered with earth. On uncovering them, one four or five feet thick and ten or twelve feet long was found, hewn as it lay, for what purpose we knew not, but we could see the marks of the tool. It had served as a fire-place. There were the charcoal and stone bed and back wall, all bearing traces of fire. Pieces of flint, a small celt of fibriolite, débris of pottery, (some dolmen, but much Roman), showed that this occupation belonged to the Roman times; that is, somewhere between 40 B. C. and 405 A. D. This menhir had been prostrate from fifteen hundred to nineteen hundred years; yet it had previously stood on end long enough time for the top to become so weathered as to be plainly distinguishable from the bottom.

There is on the menhirs quarry no mark of tool or of quarrying, yet I think they were quarried. They are so much weathered that all marks are worn away. Look at the weathering on the top of the menhir of Penmarch (Fig. 6). No traces of a quarry have been discovered, though the granite of which the menhirs are formed is the local rock, coming always near and many times quite to the surface. The menhirs have evidently been planted. In most cases they stood on the surface without any foundation, but foundations had been built where needed. In many cases the smaller end of the stone was downwards.

Flint implements and chips and broken pottery are found about and among the alignments as elsewhere over the country, especially around the foot of the menhirs, showing a prehistoric occupation; but no trace of the uses or purposes of the menhirs or alignments have ever been discovered. There have been many theories broached but no facts adduced sufficient to support them. They may have been called military camps or religious or other rendezvous for the people. They may have been tents. No trace has been found of their use as burial places, and so far as established by ascertained fact, the popular idea is as near the truth as any other, viz., that they were the columns of a sacreligious invading army, turned to stone by the wrath of an offended God.

SCULPTURINGS.

Many of these stones or monuments have marks or sculpturings on them. The menhirs of the alignments have cup markings only, and these are rare. In some cases they have been marked in with crosses, modern times, made sometimes by religious devotees, sometimes by the priests, done in order to prevent or break up any chance remaining pagan custom of worshipping, or revering, or employing these stones. The dolmens are marked with various signs, none of which have any discovered signification. They have received much attention and study, but without result.

The sculptured monuments of Brittany are all near the sea-coast. Yet there is no rule and no uniformity. Many of them near the coast are without sculptures; and this is true of an entire section or neighborhood; again other dolmens in the interior will be sculptured. Do these different sculpturings represent the dwelling places of different tribes?

CONCLUSION.

The story of these monuments has never been completely told. Their condition and position may be described, and that of the skeletons and articles or implements found. It is from these details that the history is to be obtained, of the prehistoric man who made them. They must be studied with intelligence and care. Comparisons must be made with other articles found in the same place and with the same articles in other places. A full treatment

of the subject would include an account of the beautiful polished celts of jade found in the tumuli, of the gold and bronze ornaments, of the pottery, the decoration, the art, of the tools and implements of this early people which cannot be presented within the limits to which this paper must be restricted. I omit, for the present, the cromlechs, the places of incineration, the Roman remains, and many other subjects of equal interest. Perhaps at some future time I may refer to them.

DR. N. O. HOLST'S STUDIES IN GLACIAL GEOLOGY.

BY DR. JOSHUA LINDAHL.

WE have before us two pamphlets by the Swedish geologist, Dr. Holst, of Stockholm. One of them bears the title, "Om de glaciala rullstensäsarne" ("On the Glacial Gravel-Osar"[1]); the other, "Berättelse om en i geologiskt syfte företagen resa till Grönland" ("Report on a Voyage to Greenland for Geological Investigations"[2]). The subject of these papers has so much bearing on the geology of our own country, and is so ably treated by their author, that we have thought it desirable to present the following condensed translation of them.

In the first-mentioned paper Dr. Holst propounds his new theory of the origin of glacial osar.

The history of the development of this theory is, briefly, the following: Hisinger (in some cases), Martins, Chambers, A. Erdman, Torell, and others, explained the said formation as ancient sea-shores. Hisinger (in other cases), v. Helmersen, Törnebohm, Levin, Jernström, and others, assumed that a vast deposit of sand and mud covering the country had been cut through by rivers, whose beds were gradually filled with stones and gravel. Later

[1] Geologiska Föreningens i Stockholm Förhandlingar, 1876. No. 31 (Band III., No. 3), pages 97–112.

[2] Sveriges Geologiska Undersökning. Afhandlingar och uppsatser. Ser. C, No. 81. Stockholm, 1886. Pages 1–68.

the sand and mud was washed away, leaving the stone and gravel deposits of the rivers in the shape of ridges. Hummel was the first one to recognize the fact that the existence of an inland ice must be pre-supposed as the indispensable agent in forming such ridges; but he regarded them as formed beneath the ice in tunnels excavated by percolating waters. Finally, in 1876, Holst published his new theory, which in 1878 was also used by Warren Upham in his report of the geology of New Hampshire.[1] Dr. Holst's theory stands now without a rival.

The following short extract of Dr. Holst's paper may be sufficient to explain his views. He says:—

"For a correct interpretation of the origin of gravel-*osar* it is of main importance to answer the question how it was possible for running water to deposit its silt in such shape as that of an ordinary gravel-ose.[2] There can be no further dispute that these deposits are old river-beds. How, then, have they happened to assume the form of elevated ridges, rising above the adjacent country?"

The water at the surface of the melting glacier gathers in the valleys of the ice-sheet, whence it extends its coastward course in rivers whose beds are cut down in the ice-sheet. The ice along these rivers melts faster than that farther off, and in melting it gradually releases its contents of moraine matter. This matter will then follow the water, although at a far slower rate, down to the said valleys, and is finally—at least partially—swept along into the rivers, where the gravel-grains will be worn and their angles will be more or less rounded off, according to the swiftness of the current. This same factor will also regulate the assorting of the material and determine the place where each individual boulder, pebble, or grain shall be dropped. Layer upon layer will thus accumulate in the river-bed, and, when finally the entire glacier has melted away, the accumulated silt of the former river-bed will present itself as a ridge elevated above the surrounding ground; it is an *ose.*

"To sum up:

"*Osar are formed in running water.*

"*No running water could lift all this matter to the considerable altitudes where we often find it.*

[1] Geol. of N. H. Vol. 3., pages 14-176.

[2] Swedish *ås* (pronounced *ose*), plur. *åsar=osar*—not "osars," as it is written by some authors.

"*The matter must therefore have been elevated by the ice, and must afterwards have moved down and amassed itself into osar in the above-stated manner.*"

In the second paper Dr. Holst gives an account of his visit to the west coast of Greenland in the summer of 1880. He went as far north as Sukkertoppen (lat. 65½° N., about), extending his rambles southward to Kipissako, southeast from Ivigtut[1] (lat. 61° N., about). He traveled mostly by water, in a so-called *Umiak* (boat rowed by women), but also made excursions by foot over the inland ice, ascending some of the highest mountain-peaks for the purpose of obtaining bird's-eye views over the ice and the various pinnacles—s. c. *nunataks*—which rise out of the inland ice.

After having given a general account of his travels, the author proceeds to discuss his observations under the following headings, viz.: the ground-rock, the inland ice, the kryokonite, the moraines, the upper drift deposits, the glacial clay, and the peat. We shall here reproduce the most important parts under the first five of these headings.

A. *The Ground-rock* in the district referred to is predominantly *grey gneiss*. A bed of *hälleflint-gneiss* was observed on the peninsula to the north of Tigssaluk. More variation was noticeable east and south of Ivigtut. A rather coarse-grained, well-developed *syenite* extends over the country a little to the east of Grönne Dal; a white, pretty *quartzite*, and also what may be called a *hälleflint-schist*, were seen near the southern ice-blink at Kornok, and a somewhat similar but very fine-grained *schistose hälleflint-gneiss* occurs at Kipissako.

No granite was seen north of Ivigtut; but a limited area of granitic rock extends to the north of Kipissako glacier.

In order to get some more definite knowledge of what rocks prevail in one locality, the author collected at random fifty specimens from the terminal moraine below the Ursuk-fjord glacier. Of these 50 specimens, 12 were found to be diorite; 9 grey gneiss; 7 granite (or granite-gneiss), some grey, some red; 6 grey hälleflinta;

[1] Dr. Holst mentions, as a warning to other scientists who may go to Greenland with the intention of visiting the cryolite mines at Ivigtut, that admission to those mines is absolutely prohibited to all strangers not presenting a written permit from the head office at Copenhagen. He might have added, that such a permit is *never granted*.

4 hälleflint-schist; 3 red granite, of more than medium-coarse grain; 2 grey granite—otherwise like the last-named variety; 1 red hälleflint gneiss; 1 quartzite and 1 quartzite-sandstone; whilst the remaining 4 specimens were put down as undeterminable. In the same moraine were also noticed limestone, red fine-grained sandstone, coarser sandstone, and sandstone conglomerate, sometimes with nodules of jasper and diabas. The sandstones and quartzites are very compact, as is generally the case with older sandstones, and bear a complete resemblance to many Swedish sandstones generally regarded as *Cambrian*. C. Pingel (in 1843) expressed his opinion that they are *Permian;* and K. J. V. Steenstrup (in 1877) takes Pingel's side, and (in 1881) declares that there can be no reason for a different view as long as no petrifactions have been found in the sandstone. Yet there is no more reason to regard this rock as belonging to the Permian formation than to almost any other formation. Numerous dykes of diabase are met with in the southern portions of the district visited by Dr. Holst, all the way from Kipissako to Fredrikshaab. They are particularly abundant on the Tassiussak-fjord, and not less than twenty parallel dykes of greenstone were counted within a space of five hundred feet on the island Kikertarssuak, at the inlet to this fjord. East-southeast from Grönne Dal occurs a peculiar diabase breccia, and, close to it, dykes about a yard wide of a very fine-grained red rock, microscopically determined by Dr. A. E. Törnebohm[1] as a fine-grained *syenite.*

B. *The Interior Ice-covering.*—Previous explorers of the inland ice have made the observation that moraines are found on the surface of the ice only near land, while the inner expanse of the ice-sheet is earthless, except the occurrence of the so-called *kryokonite.* What else it carries along is hidden more or less deeply in the mass of the ice. Knowing this, Dr. Holst thought it more fruitful to study the ice near its borders than to undertake time-wasting excursions into the interior.

The inland ice expands in a continuous sheet from the mountains of the coast-lying land eastward beyond the horizon, only interrupted by the "nunataks" and the moraines. The former occur very sparingly, only the high peaks of the underlying mountains rising

[1] A. E. Törnebohm: Mikroskopisk undersökning af några bergartsprof från Grönland insamlade af Dr. N. O. Holst. Geol. Fören. Förh. Bd. 6, p. 692.

above the ice. Of the moraines may be especially mentioned the morain-osar, deposited on the ice parallel to its border, and in undulating or even horseshoe-curved lines, following at some distance the headlands jutting into the ice-sheet. These moraines Dr. Holst proposes to call *border-moraines* ("rand-moräner").

The ice within a hundred feet from its borders invariably presents a slope toward the border, though generally not so steep as to render the ascent at all difficult. Farther in the slope is much less marked, though there appears to exist a general rising toward the east, whilst the surface everywhere presents vast undulations.

The border of the ice appeared to have retreated quite recently in many places; in others it had evidently advanced. This seems to be the necessary effect of the varying amount of precipitation of snow or rain over the glacier-basin, causing the glacier itself to vary in volume. The snow fallen during the winter seems to remain much longer on the inland ice than on the land. Thus, at Atarngup, above the Tassiussak-fjord, on the 25th of June the inland ice was covered with snow. At the Fredrikshaab glacier, on the 4th of July, the snow had melted near land and around the "nunataks," but remained over a great part of the ice-sheet, although numerous bare spots were visible. Still later in the season—by the middle of September—Dr. Holst made an excursion over the inland ice to the north of the Kipissako glacier. All the snow from the last winter had disappeared, but some new snow, blended with rain, had fallen and frozen to a thin crust over the ice.

On the surface the inland ice either presented the appearance of a compact mass of coarse crystallinic texture, reminding of the grain of common rock-candy, or else it is honeycombed by the solar heat and shows intersecting systems of parallel plates, apparently the remnants of large ice-crystals, often several inches long, which have wasted away, only leaving the frame, as it were, on which they were built. These plates or tablets are highly mirroring, reflecting the solar rays in all directions, depending on the position of each individual crystal. The ice in the wild, mountainous regions of Southern Greenland is, as a matter of course, very much broken up by crevasses. Wherever the ice pushes forward and downward over an escarpment of the underlying ledge these crevasses, with great regularity, cross the direction or course of the glacier. Of most frequent occurrence, however, are the cracks which run at right angles to the borders of the inland ice.

Although the ice in the said mountainous district is everywhere crevasse-torn, it is not necessarily so in other localities. Where the underlying ground is level or only gently rolling, the moving ice is, no doubt, entirely free from cracks.

The local direction of motion must, of course, to a great extent conform to topographical conditions. Thus, in deep valleys glacial striæ may be found to run in all possible directions, always following the course of the valley. In order to find the general direction of the motion of the inland ice, one must study the striæ on the high plateaus. My observations in such localities indicate a direction from northeast or east-northeast.

The vastly broken aspect of a Greenland landscape cannot be explained as solely a product of the erosive force of moving glaciers. It is true that the material produced by this erosion is only to a small extent left on the land—where the soil is, indeed, very thin—whilst by far the greater part is deposited as silt in the sea. But if we suppose this silt to spread over the bottom of the sea for some miles from the coast and to have the thickness of several rods, still this cannot approximately account for the enormous excavations of the land. These must date farther back than the glacial period. The glaciers may, however, have plowed up and scooped out the loose sediments from earlier ages in the vast valleys.

On the inland ice occur *moraines* and *kryokonite* (glacial dust), besides patches of *vegetable matter*. The moraines are limited to the borders of the inland ice around the nunataks as well as along the coast-line. The kryokonite mostly accumulates between the moraines thus near to land, but is not altogether absent even from the high interior tracts of the ice-sheet. Vegetable matter occurs but sparingly on the ice. West of Kangarssuk, half a mile from land, were noticed some leaves of grasses, Betula, etc. They were not scattered, but heaped up in a pile—which seems to indicate that not wind, but water, had transported them to that position.

C. *The kryokonite* is extensively distributed over by far the greatest part of the inland ice, as well as over most of the local glaciers, though it may occasionally be hidden under snow or ice formed by the freezing of the thaw-water.[1] It varies, however,

[1] = Swedish smältvatten. The word, although not found in Webster, may serve to express the water formed at the surface of the ice by thawing.

considerably in quantity. In many places, especially far inland, the kryokonite spreads only as a light shade over the ice, whilst near to land it exists in far greater abundance. At Fredrikshaab's ice-blink the border-ice was dirty from immixture of kryokonite and separated from the higher-located, cleaner ice by a sharply-defined line parallel to the foot of the inland ice, this line having an elevation of six hundred feet over the foot of the ice.

The kryokonite has a dirty gray color, and upon superficial inspection appears like clay; but, on closer examination, it will be found to consist of very fine sand. Quite often it is formed in little balls as big as beans, which readily absorb heat from the sun, causing the underlying ice to melt, so as to produce the so-called "organpits." It may occasionally be washed down with the thaw-water from the higher places and then accumulate in patches. On the Arsuk glacier some such patches, about one square foot each in extent, were covered with kryokonite to a depth of three inches. It is not always easy to tell the difference between moraine-sand and kryokonite on the ice-rivers, where the moraine matter exists in every grade of fineness—from coarse gravel and sand to nearly impalpable dust, like the kryokonite. On the higher parts of the inland ice, where no moraines are found, this difference does not exist.

The following table shows the chemical composition of the kryokonite. No. 1 was a sample taken by Baron Nordenskiöld on lat. 68° 20′ N. Nos. 2–6 were taken by Dr. Holst. For comparison is added an analysis (A) of gneiss from Ostergothland, according to Dr. H. Santesson.

	1	2	3	4	5	6	A
Silicic acid	62.25	62.93	62.74	56.30	60.67	60.55	63.72
Titanic "	....	0.37	....	....	....	....	....
Alumina	14.93	12.24	14.18 (P[1])	16.45	15.63	14.97	15.74
Peroxide of iron	0.74	6.43	....	....	....	....	2.74
Protoxide "	4.64	....	3.90	4.10	6.35	6.28	4.31
Manganous oxide	0.07	0.32	0.92	0.54	1.10	0.14	1.29
Nickelous "	....	None	....	....	....	....	....
Cobaltous "	....	None	....	....	....	....	....
Talc	3.00	....	3.01	2.44	2.37	2.54	1.40
Lime	5.09	5.61	3.02	3.62	3.70	3 73	3.56
Soda	4.01	7.75	3.47	4.94	3.79	3.70	1.64
Potash	2.02	2.22	1.26	2.52	2.52	2.99	3.72
Phosphoric acid	0.11	None	....	....	....	....	....
Chlorine	0.06	....	....	....	....	....	....
Water	3.20	2.23	4.25	9.69	4.78	4.89	1.00
	100.12	100.10		100.60	100.91	99.79	99.28

[1] Including hygroscopic water, 0.34.

In his "Account of an Expedition to Greenland, 1870," Nordenskiöld gives the above analysis No. 1, and, on the strength of it, pronounces the kryokonite "a trachytic sand of a composition (*e. g.*, the amount of sodium) which indicates that it does not derive its origin from the granite-bearing region of Greenland." He leaves the question open whether it is derived from the basalt region or from volcanoes supposed to exist in the interior of Greenland, or whether it is of meteoric nature. He regards it as a distinct species, for which he gives the chemical formula, and even states that its crystal form is probably monoclinic. By comparison with the analysis (A) of a Swedish gneiss, it becomes evident that his conclusions are invalid. Evidently the analyses point to the primitive rocks of Greenland as the origin of the kryokonite. Even the high percentage of soda has no great bearing on this question, as many Swedish gneisses[1] have a higher percentage of soda than the above No. 1.

Dr. Holst devoted special attention to the kryokonite in Greenland, and collected samples of it from ten different localities between lat. 61 N. and 65° 25′ N.[2]; and he came to the conclusion that this substance is nothing but the finest till separated by repeated washing.

The thaw-water from the surface of the inland ice penetrates through cracks into confluent gutters down in the moraines in the deeper parts of the ice, and, washing out the finest till, it continues its course until it connects with similar gutters, carrying water from higher-located tracts. Hydrostatic pressure will then force back water toward the lower tract. The suspended moraine matter will follow; but as soon as equilibrium is restored it will settle in pores and cracks of the ice. The water may but rarely reach the surface immediately. But when the moving glacier encounters an elevation of the ground, the lower portions of the glacier will be pressed up to a higher level. As the ice is melting away from the surface the enclosed matter will gradually appear at the top. Upon reaching the borders of the inland ice it will be carried away by the glacier-rivers and deposited in the sea. These rivers in Greenland are

[1] According to Santesson's "Kemiska Bergarts analyser." Sveriges Geol. Undersökning.

[2] Nordenskiöld's samples were all taken from nearly the same locality, viz., about 68° N. lat.

very turbulent, and the kryokonite, therefore, mingles with the clays and sands, which are whirled down by them into the sea. But if such inland ice were advancing over a plain, and the kryokonite were washed out from it by quietly-running water, it would, no doubt, get an independent geological significance.

This theory presupposes the existence of kryokonite, not only on the surface of the inland ice, but also in its deeper parts. That this is the actual case is plainly visible near the borders of the ice.

Microscopical analyses of the kryokonite were made in 1881 by A. von Lasaule, F. Zirkel, and E. Swedmark. All agree in the main: *The kryokonite contains nothing but the ordinary components of primitive rock.*

Professor Zirkel found Dr. Holst's samples to contain mainly the following minerals, viz., quartz, orthoclase, plagioclase, greenish and brownish mica,—which he supposes to be a magnesia mica,—and colorless potassium mica (this last mineral occurring but rarely) He also found some hornblende, garnet, magnetite, and (doubtfully) traces of titanite and epidote. In all cases the principal constituents were quartz, magnesia mica, and feldspar. The thinnest scales of mica pierce through the feldspar fragments, just as they do in the gneisses. Metallic iron was never identified in the samples. Professor Zirkel calls particular attention to the total absence of any augite, olivin, or glass. Both chemical and microscopical analyses agreeing, it may be regarded as a settled fact that the kryokonite has the same origin as the moraines. It is far more difficult to solve the question regarding the geological significance of the kryokonite. During his visit to Greenland, Dr. Holst was inclined to suppose that it nowhere forms independent deposits, but always occurs commingled with the clays and fine sands of the till, the kryokonite, as to its grain, being intermediate between the two. It is sand, but considerably less palpable than any ordinary kind of sand. However, since he had opportunity of studying the *loess* in Saxony, he came to the conclusion that *the loess is nothing but kryokonite.*

Considering the loess (kryokonite) as a product of repeated washing processes, in the manner above stated, it is easy to conceive why it has reached such remarkable extent and purity.

The State Geologist, E. Swedmark, having examined microscopically samples of loess collected at Ebendorff, near Magdeburg, and

at Dresden, found them to consist of fine rock-powder, in which he identified fragments of *quartz* as the most prominent constituent, besides feldspar, plagioclase, green hornblende in considerable quantity, mica (mostly biotite), a trifling amount of magnetite, numerous dendritic or, sometimes, kidney-shaped grains of an *ochre*-like mineral, and fine particles of *clay* and *limestone.* Such a composition (says he) indicates certainly that this loess leads its origin substantially from disintegrated primitive rocks (gneiss or granite) and diorite.

The dust on the inland ice of Greenland offers a suitable soil for quite a number of small algæ. Professor V. B. Wittrock examined some of the samples of kryokonite, and the results of his investigations are embodied in his paper, "Om snöns och isens flora." [1]

(To be concluded.)

DESCRIPTION OF A NEW PRAIRIE MEADOW MOUSE (ARVICOLA AUSTERUS MINOR) FROM DAKOTA AND MINNESOTA.

BY DR. C. HART MERRIAM.

A LARGE series of meadow mice of the genus *Arvicola*, collected during the past two years in Minnesota and eastern Dakota, comprises but two species, which, in the field notes of the collector, Mr. Vernon Bailey, are designated respectively as "upland" and "lowland" meadow mice. The "upland" form is never found on the marshes, but the "lowland," which is most abundant in wet meadow lands and in the neighborhood of streams, sometimes occurs on the dry prairies in company with the other. Externally, some of these mice resemble one another so closely that sharp discrimination is necessary for their separation. A glance at their teeth, however, shows that they belong to different sub-genera. The "lowland" species has two external closed triangles on its last upper molar, a postero-internal loop or "spur" on its middle upper

[1] A. E. Nordenskiöld : Studier och forskningar, föranledda af mina resor i höga norden. Stockholm, 1883, pages 63–124.

molar, and three internal and at least two external closed triangles on its front lower molar—and consequently is a *Myonomes*, closely related to our common eastern meadow mouse, *Arvicola* (*Myonomes*) *riparius*. The "upland" species has but one external closed triangle on the back upper molar, lacks the "spur" of the preceding tooth, and has but two internal and one external closed triangles on the front lower molar—in other words is a *Pedomys*, nearly related to the prairie meadow mouse of the Mississippi Valley, *Arvicola* (*Pedomys*) *austerus*. For purposes of critical comparison, therefore, the remaining sub-genera of *Arvicola* may be summarily dismissed. The sub-genus *Pedomys*, according to Coues, the latest monographer of the group, contains but the single species, *austerus*. He also placed in this sub-genus, and in fact as only sub-specifically separable from *austerus*, a very different mouse (namely, his *Arvicola austerus curtatus*) which is not a *Pedomys* at all, but, as I have recently shown, belongs to the sub-genus *Chilotus*. This leaves *austerus* as the only species with which Mr. Bailey's "upland" mouse may be compared. The principal difference is in size, the new form being a miniature of *austerus*. The case has a parallel among birds, in the hairy and downy woodpeckers (*Picus villosus* and *P. pubescens*),

2245 male *Arvicola* (*Pedomys*) *minor* Merriam. 1 and 2, skull from about and below ×2; 3, upper molar series, ×5; 4, lower molar series, ×5.

except that in the case of the mice the ranges of the two are not known to overlap. In my series of considerably more than a hundred specimens of *austerus* proper I do not find a single adult indi-

vidual as small as the largest of about thirty specimens of the northern animal. The average difference in length, without the tail, is nearly 25 mm. (about an inch). In typical *austerus*, the hind foot averages 19 to 20 mm., while in the new form it averages but 16 to 17 mm. In adult skulls of *austerus* the average basilar-length falls between 24 and 25 mm.; in the northern form it falls between 20 and 21 mm. In reference to its diminutive size, I have named the northern mouse

ARVICOLA AUSTERUS MINOR, sub-sp. nov.
Northern Prairie Meadow Mouse.

Type $\frac{3827}{4406}$, male, Merriam Collection. From Bottineau, Turtle Mt., Dakota, August 27, 1887.

Description of Type.—Similar to *Arvicola austerus*, but much smaller; length from end of nose to tip of tail vertebræ (measured in the flesh), 133 mm.; tail vertebræ, 36 mm.; hind foot, 16.5 mm.; ears rather prominent, slightly overtopping the fur.

Color.—Upper parts uniform grizzled gray; under parts whitish, washed with pale cinnamon. Viewed from behind, looking away from the light, the entire head, back and sides appear to be finely and closely lined with silvery. The fur of the belly is plumbeous basally and nearly white apically. There is no sharp line of demarkation between the color of the sides and that of the belly. Tail bicolor, the light color of the under surface reaching well up on the sides.

Description of other Specimens.—The type, which is from Turtle Mt., Dakota, is very closely matched by specimens from several places in the Red River Valley (particularly from Travare, Dakota, and Ortonville, Minnesota); and by a few of the Elk River specimens. A male from Elk River (No. $\frac{2491}{3001}$), collected June 2, 1886, is almost a duplicate of the type, except that the belly is darker—it is more sparsely haired, and the plumbeous basal portion of the fur shows through. Other specimens from Elk River have the upper parts strongly suffused with brown, and the belly strongly washed with cinnamon.

In others there is as much whitish on the belly as in the type; while in others still the under parts are of the "muddy rust color" so often seen in true *austerus*. This is pronounced in No. $\frac{4184}{4723}$,

male, from Elk River. The variations in color of under parts do not seem to depend on age, sex, or season, though of course the fur is everywhere longer and more dense in winter than in summer, as is the case in all northern *Arvicolæ*.

General Remarks.—*Arvicola minor* is so different from all American *Arvicolæ* except *austerus* that comparison with others is unnecessary. Lest, however, there should be any question as to its distinctness from "*A. cinnamonea*" of Baird, which is said to have come from Pembina, I have measured the skull of the type (No. 591, male, U. S. National Museum—the skin has been lost), and find it to be as large as that of *austerus* proper. And Baird's measurements of the animal show that it was larger even than average *austerus*. The dental peculiarity pointed out by Baird as one of the distinctive characters of the supposed species, namely, the fact that the angular depressions in the crowns of the back upper molars communicate across the teeth, forming transverse loops instead of lateral triangles, I incline to agree with Coues in considering abnormal.

ON ARCTIC CHARACTERS OF THE SURFACE FAUNA OF THE BAY OF FUNDY, AND THE CONNECTION WITH A THEORY OF THE DISTRIBUTION OF FLOATING MARINE LIFE.

BY J. WALTER FEWKES.

SEVERAL naturalists have shown a similarity between the fauna of the Bay of Fundy and that of the waters of Labrador and Greenland. This comparison is of great interest to students of New England marine zoology.

As the evidence thus far adduced is mainly drawn from studies of littoral animals, it has seemed in place to test the theory by a consideration of oceanic genera. It would be pre-eminently fitting to consider floating marine life with this thought in mind, and as the young of a large number of marine genera are free-swimming,

it would be well to include them with true oceanic genera in this connection. I undertake this comparison with more enthusiasm, as it has been my good fortune to examine and publish notices of nomadic animals which have been collected in high latitudes by Lieutenant Greely, and since it has been possible for me to study the marine life of Grand Menan and the islands off the coast of New Brunswick.[1]

A study of the surface life of the Bay of Fundy reveals interesting facts in the theory of the Arctic relationship of the life of these regions.

Nomadic animals which live in the high seas, generally upon the surface of the ocean, are known as pelagic animals, and constitute what is called the pelagic fauna. While this fauna is preeminently the fauna of the ocean and is found best marked at a great distance from the land, it often happens that winds and currents sweep its members into our bays and harbors, and we in this way become familiar with it. Like all large bays with open access to the ocean, the Bay of Fundy has a pelagic fauna. It is, in fact, the same or nearly the same as the pelagic fauna of the coast of Greenland.

Animals which are strictly pelagic are never limited to the coast, to the littoral fauna, or to the sea bottom. They never become attached, but crawl about, or rest upon the sea floor. A large number of marine animals have young which resemble pelagic organisms in these nomadic habits. They also wander about and are carried hither and thither by ocean currents independent during their youth of the coast or the sea bottom. As they reach maturity, however, they sink to the sea floor, and there remain, either attached or limited in their movements to a small area. These young or larvæ, as they are called, may also be included in the pelagic fauna as long as they preserve this free-swimming feature. This larval and adult pelagic fauna differs in different regions of the ocean, and that of the Bay of Fundy differs in a marked manner from that of the bays of southern New England.

A study of the pelagic fauna of the Bay of Fundy shows that it has a boreal character. While it is in many respects like that of

[1] I have already elsewhere (Bull. Mus. Comp. Zool., vol. xiii., No. 6) considered the boreal relationships of the medusan fauna of the Bay of Fundy.

Massachusetts Bay, it is in marked contrast with that of the bays south of Cape Cod. We may, in fact, say that the fauna of the Bay of Fundy is more closely allied to that of the coasts of Greenland, as far as its pelagic life is concerned, than it is to that of Narragansett or Buzzards Bay. The reason for this diversity in the inhabitants of bodies of water so near together, and the resemblances of faunæ of localities so far apart, may easily be found in the direction and character[1] of oceanic currents to which the distribution of marine life is almost wholly due. Moreover, the surface life is in a measure dependent on the amount of water brought to the coast by the tides. The greater the volume of water which sweeps into the bay, the larger the number of animals which it brings with it, if other conditions remain constant. The great tides of the Bay of Fundy are admirable for the purpose, and they bring to the shores of New Brunswick a wealth of surface life seldom equalled and never excelled elsewhere on the coast.

There is a strict line of demarcation between the surface fauna found south of Cape Cod and that immediately north of the same headland. It would seem the most natural thing in the world that an animal which passes its life floating or swimming on the surface waters of the ocean should live equally well in Narragansett Bay or the Bay of Fundy. That is, however, not the fact, for while stragglers from the true Arctic faunæ of the waters of New Brunswick may sometimes be found at Newport, there is as marked a difference in the facies of the faunæ of the two regions as between those of the two sides of the Isthmus of Panama. Why is there this difference?

The answer is found in those limitations in the distribution of animals brought about by the differences in the temperature of the sea. Everyone who has tried the ocean bathing in these two localities knows how much warmer the surface water south of Cape Cod is than that of Grand Menan, and this difference of temperature means life or death to the delicate creatures which live in it. The animals south of Cape Cod are those of warmer waters, and some of them have their home in the Gulf Stream, while those in the Bay of Fundy are pre-eminently of polar origin, and can endure with impunity a fall in temperature which would kill the

[1] The boreal life of the Bay of Fundy is thought to be due to the Labrador current.

inhabitants of the Gulf of Mexico. As the study of animals which are not nomadic teaches that those of the Bay of Fundy are most closely allied to the inhabitants of the colder waters of the Arctic,[1] so it is with the surface life. Both tell one and the same story, that the assemblage of life in the sea which constitutes the fauna of the Bay of Fundy is Arctic in its affinities. To demonstrate the Arctic character of the free-swimming life of the Bay of Fundy would seem to necessitate a minute comparison of faunal lists from the two localities. It is not wholly necessary for our present purposes, however, to make such an extensive comparison. Some of the more striking instances of floating boreal life will suffice.

Of all floating animals the jelly fishes are well suited for this study. Among the Medusæ we have marine animals, as well known as any, from which to test our theory. The following may be mentioned as some of the Medusæ of the Bay of Fundy which are markedly Arctic. The large and beautiful *Cyanea arctica,* one of the most stately forms of discophorous jelly fishes, is pre-eminently an Arctic genus. *Callinema,* first described by Professor Verrill, another large Medusa of the same group, and has never been seen south of Cape Cod. Among Hydromedusæ the beautiful *Turris episcopalis* is boreal in its distribution, and rarely gets south of the coast of Maine. *Staurophora* and *Halopsis* are northern genera. The beautiful "sea necklace," *Nanomia cara,* one of the most exquisite genera of marine animals, has been seen in the icy waters of Robeson's Channel by Arctic navigators. It is rarely seen south of Cape Cod, in Narragansett Bay, but at Grand Menan hundreds of specimens, some of which were four feet in length, were taken from the landing places, and at other points on the shore.

If we, in fact, take the faunal lists of the Medusæ of the Bay of Fundy and compare them with those from Greenland and neighboring waters, we find, as far as our knowledge goes, a strong resemblance between the medusan life in the two regions. Of course there are genera occurring in the waters of Greenland which are not to be found in the Bay of Fundy, and *vice versa,* but that does not change a belief in a general statement that the marine animals of the two localities resemble each other in facies. If we

[1] The surface animals of the Bay of Fundy, although Arctic, are not supposed to be of the extreme polar types. For obvious reasons little is known of the facies of polar marine life.

should carry our comparisons of the surface life of the two localities among other groups, we should find as marked a similarity there as among jelly fishes. One or two examples may suffice for illustration.

There is no pelagic mollusc which is more truly boreal than the well-known *Clione borealis*.[1] This pteropod rarely ventures into Narragansett Bay, is more common as we go north, and was at one time observed in great abundance in the Bay of Fundy. In the North Atlantic and on the shores of Greenland it is found at times in countless hosts.

Among the pelagic annelides, one of the most common at Grand Menan is a species of *Sagitta*, which bears a strong resemblance to a *Sagitta* found in Lady Franklin Bay by Lieutenant Greely. This Arctic *Sagitta* is markedly different from the *Sagitta* of Narragansett Bay.

The species of Appendicularia found in the Bay of Fundy is different from that of Newport, and appears to be the same as that recorded by Murdoch from Point Barrow. This pelagic ascidian, as is well known, is found in some places enclosed in a gelatinous envelop called the "*haus*," which serves as its protection, or for other purposes. Although I have repeatedly taken Appendicularia in Narragansett Bay, I have never found the "*haus*" in those waters. From Murdoch's description of the Arctic Appendicularia and from its size, I am inclined to think that the Bay of Fundy Appendicularia[2] will also be found with houses. The mere fact alone that the Arctic Appendicularia has the house, so-called, is not characteristic, for animals of this or allied genera in warmer waters have the same structures.

The resemblances between these two marine faunæ suggest interesting general questions of distribution. Students of the geographical distribution of terrestrial animals easily recognize the facies of organic life from different continents. A collection of the land animals of Australia has an altogether different appearance from one from Europe, while those from South America are different from those of North America. While the characters which impart

[1] I have taken many specimens of the larva at Newport.

[2] It is undoubtedly true that the Bay of Fundy Appendicularia is a different species or even genus from that of Narragansett Bay. It closely resembles the genus *Oikopleura*.

this difference are hard to define, they exist and are recognizable by a specialist. In the Museum of Comparative Zoology at Cambridge this difference is shown by faunal assemblages of life from different regions of the globe, each arranged in different rooms, known as the North American, European, African, etc. The idea is a grand one, and to a student of physical geography of the greatest importance.

As in the study of land animals there is a different facies to the assemblages of life from different quarters of the globe, so in the ocean there is a different facies in collectious of animals from different regions of the sea. Place side by side a number of Arctic species of shells and those of the same genera from the tropics. If the shells be representative, the conchologist need not hesitate long as to their homes. The dull, cold, little variegated molluscs of the Arctic contrast markedly with the brilliant, gaudy shells of the warmer zones. Passing to the inhabitants of the ocean, the deep-sea animals have an altogether different facies from the surface animals. The characteristic facies of great regions of the ocean are as noticeably different as those which naturalists have long recognized among terrestrial animals. It is not in place here to point out the different regions into which the oceanic faunæ may be divided, but it would be interesting in considering the causes of the boreal character of the pelagic life of the Bay of Fundy, as they involve a general consideration of the laws which have led to the diversity of these faunæ. I consider the temperature of the water as a most important influence in causing the diversity of life in the ocean. Variation in temperature is probably more important than pressure in the bathymetrical distribution of deep-sea life. The difference in temperature of the surface of the ocean is one of the most important factors in determining the character of pelagic organisms. As we have a variety in surface temperatures, we have a diversity in the surface fauna. We have, it is held by some, a repetition of Humboldt's law of the modification of plants in altitude, and the correspondence of latitude with altitude, in a change in character of animals by depth resulting from several conditions, among which may be mentioned pressure and temperature. Whenever the temperature of the deep-sea becomes a surface temperature, as in the Arctic Ocean, then, it is argued, we may look for allies of deep-sea animals.

The two great tendencies at work in the modification, as in the geographical distribution, of pelagic animals, are cold currents of water bringing them into lower and warm currents transporting them into higher latitudes.[1] The physical result in both instances is a change in the temperature of the water and other conditions in which they live. Where the currents generally set from the south to the north, as on the eastern coasts of the Northern Hemisphere, we may expect a relationship to the tropics in higher latitudes than where the currents are from the pole. The former currents carry the warm belt into higher, while the latter restrict it to the lower latitudes. It is known that the distribution of coral reefs on the western and eastern coasts of the continents has a direct relationship to the direction of the ocean currents, and that where the current is from the equator to higher latitudes (Eastern coasts) coral reefs extend farther from the equator than where the general direction of the oceanic rivers is from colder to warmer latitudes.[2] This can readily be seen by consulting a map of the earth's surface where all the great coral reefs are on the eastern side of the continents, and where also all the great oceanic currents are setting from the equator towards the poles.

This law in the distribution of corals, pointed out by Dana, is believed to hold also in the case of other animals, which, unlike corals in their mode of life, are not fixed, and have left no hard secretions to denote their former or present existence.

It will be seen by a consultation of Krümmel's maps of the distribution of surface temperatures in the Atlantic, and by a reference to the chart of the surface temperatures published in *Science* for December, 1887, that the Bay of Fundy does not lie in the same isothermal zone as do the waters of the coast of Greenland. Perhaps these zones were only intended as approximations, and the temperature of the water of the Bay of Fundy may not be higher than of that of the coast of Newfoundland. In the chart referred to, the Bay of Fundy is near the southern limit of the zone of low surface temperature, and the high tides may account for the large percentage of boreal surface animals in its waters.

[1] The pelagic life washed to the coast of England will probably be found to differ from that of Labrador under the same latitude.

[2] Possibly due also to the food of the coral, minute floating life, which is furnished in greater abundance on account of the currents.

The student of the geographical distribution of pelagic life will, I believe, find a correlation between the facies of this fauna and the zones of equal temperatures of the sea. An improvement in the projection of these zones on the maps of oceans will lead to a corresponding advance in our knowledge of the distribution of marine life characteristic of the surface of the sea. If we accept the proposition that the pelagic fauna of the Bay of Fundy is Arctic in its facies, it becomes an interesting thing to study carefully this fauna in its relation to animals found in deep-sea.[1] Is there a closer affinity between animals found on the surface of the ocean, where the water has an Arctic temperature, and those of the deep water where the temperature is the same, than between those of the surface of the ocean in the tropics and deep water, where there is a marked difference in temperature? Although marine zoology has never been a primary object of polar exploration, it is probably true that most interesting results are to be looked for if the attention of Arctic explorers is turned to the importance of this study. Let me call to mind one interesting aspect of the study of marine animals from polar regions. Now that the character of the deep-sea fauna may be said to be known, as far as its general facies is concerned, it may be well to ask whether there are any places on the globe where conditions found in deep water are repeated in shallow seas, and where there is a similitude in the environment under which life exists.

There are two conditions under which deep-sea life is placed which may be considered. The first of these is pressure, a condition which we can normally expect to find only in the sea at great depths; the second is a low temperature of the water which exists in certain oceans at the surface.[2] A third condition, viz., the amount of light, is in a way connected with the second. In my consideration of the subject it is not discussed.

[1] The explanation advanced by physical geographers that cold waters near land are sometimes due to a replacement of surface waters by those from great depths may explain many peculiarities in the distribution of life.

[2] Murdoch's record of pelagic animals taken from the Arctic Ocean when the temperature was 29.1° F., is among the most valuable which have been made on the character of pelagic life in water of this low surface temperature. If they are not the first observations on this subject, they are certainly the most complete.

In many invertebrate animals the difference in pressure at 1000 fathoms and at one fathom is endured with impunity by the same species. Difference in pressure under which a deep-sea animal is placed is not believed to be the influence which is most important in the determination of the limitation of deep-sea faunæ to certain depths.

Invertebrate animals, however, which can endure equally well enormous pressures or live near the surface without harm, are delicately susceptible to a change of temperature of a few degrees. Temperature has drawn even in littoral zones invisible limits or lines of demarcation, which are partially known to naturalists. The laws of the diminution in heat with the depth has also been shown. It is known that the bottom temperatures of deep-seas are surface temperatures in some parts of the globe. If temperature. is an important condition of the environment of deep-sea animals, it is significant to discover what the character of the marine life is in latitudes where the temperature is that of the deep sea and where it is constant.

The polar oceans show on the surface of the water the low temperatures of the deep seas. Those temperatures, to find which in tropical oceans the plummet has to go many fathoms below the surface here come to the surface, and are its ordinary temperature

It is interesting to discover whether in places widely separated in latitude, but where the temperature of the sea is the same and constant, we find any uniformity in the ocean fauna. It must be recognized that we have in the great body of water which composes the ocean a mass of liquid, the temperature of which is modified by local currents, vicinity to the land, and other conditions. As a general law, to which there are some exceptions, it may be said that the temperature of the sea decreases as we sink below its surface. Of all places in the ocean, where the limits of variations in temperature are small, none equals the deep water. A maximum variation in the tropics may be found on the surface and in the neighborhood of the coast line. The minimum is far below the surface in the deep water.

It may readily be imagined that, if there were no distribûtion of heat in the ocean by currents as we go north or south from the equator, we should find the isothermobatric lines, or lines

of equal deep-sea temperature, gradually approaching the surface of the sea until we come to the icy waters of the pole. Here we should find a law of the distribution of heat similar to that which holds on land, where there is a constant relationship between the altitude above the level of the sea and the latitude as far as the diminution in temperature is concerned, unless modified by local conditions. As we ascend the tropical mountain the heat, as a general thing, diminishes; the same is true as we go below the ocean. As we increase our latitude in either case, the temperature follows a common law in its change, approaching *pari passu* the level of the sea.

It was long ago recognized that the distribution of plant life on a tropical mountain is correlated with the change in temperature, and that in ascending a tropical mountain-side we pass through the three climatic zones. The author does not know how far this theory is now accepted by botanists, but it is interesting to see whether a similar law holds in the ocean where there is a like change in temperature. We know that there is a peculiar fauna of those animals which habitually live on the bottom in the deep sea. We know there is an æquatorial marine life which is confined to the surface of the ocean, represented by *Physalia*, *Veletla*, and others. Associated with the latter are other genera, as *Atolla*, which sometimes go down to 1800 fathoms below the surface. Are there any medusæ at 1800 fathoms which rise to the surface without destruction? I think there are, although our facts are not decisive enough to prove it.[1] I also believe that there are nomadic deep-sea animals which in the tropics cannot rise through the stratum of warm water above them without harm, but it by no means follows that where these low temperatures of the deep seas become surface temperatures they may not come to the surface of the sea.

It seems probable that the cold areas of deep seas have preserved uniformity of environment for a much longer period of time than warmer areas of the surface. The water of the ocean in different strata is, of course, varying its temperature, but there are certain positions where an almost uniform temperature has been kept up for long periods of time. The uniformity of conditions in

[1] Since this was written a large number of observations by Chun have shown the truth of this belief.

the cold polar seas, as far as temperature of the water goes, is greater than under the equator at the surface. Consider the waters of the polar ocean covered by a palæocrystal ice, and those unprotected under the burning tropical sun. In the one there is certainly a minimum of variation in temperature, in the other a maximum, as far as the water is concerned. If environment, if uniformity of conditions, has anything to do with variation in forms of life or with the preservation of ancestral features through long periods of time, should it not appear in the animals which live under these conditions?

There is a certain parallelism in the animals of cold and warm oceans and those of deep seas and littoral zones. It is, of course, impossible to link together what we know of deep-sea life with that of the polar region with any hope of a satisfactory answer as long as our knowledge of either is incomplete. Fortunately the character of deep-sea life in late years has been investigated. As far as this problem goes, the least satisfactory part is that which pertains to the *nomadic* deep-sea genera. With regard to the marine life of the polar regions, where the deep-sea temperatures become surface temperatures, much remains to be done. We know the littoral marine Invertebrata of the polar sea better than those of many bays contiguous to our own country, but the subject of the marine surface fauna is yet to be more fully investigated. If polar exploration is to be continued, as there is no doubt that it will be, a more complete study of the marine life would be an important object of such exploration, and would be of value to our knowledge of the geographical distribution of marine animals. It would be interesting to take up again the somewhat threadbare discussion of a relationship between the Arctic and deep-sea faunae. It might verify a prediction that it is possible to recognize ancestral forms among those which people the icy waters of the polar seas. The theory of the Arctic character of deep-sea faunæ is by no means a new one, and as long as the zone of deep water from 100 to 300 fathoms was studied there seemed to be a marked likeness between these two faunæ. When, however, the variegated fauna of the abysses of the ocean came to be studied, it became more difficult to found resemblances between deep-sea animals and those of the poles. Our comparison of deep-sea floating life with the polar introduces a new phase in the discussion,

as the animals which we are considering are not attached, but are nomadic in nature. There is nothing to prevent a comparison between the nomadic life of deep water and that of the Arctic, even if the facies of the abyssal zone is different from that of any oceanic fauna of the globe. While the difficulties in the investigation of the animals of the polar regions are such that much remains yet unknown in relation to the surface life of these latitudes, the similarity of that of the Bay of Fundy to it, if such a likeness really exists, renders this study comparatively easy. It becomes imperative, then, to know accurately the facies of this fauna if one would use this knowledge in comparisons with deep-sea faunæ.

CEREBROLOGY AND THE POSSIBLE SOMETHING IN PHRENOLOGY.

BY S. V. CLEVENGER, M.D.

TEN years ago, in the *American Journal of Nervous and Mental Disease,* I reviewed the history of brain studies, from Erasisratus to Ferrier, and described the convolutions and fissures with their equivalent names as used by English, German, French and Italian investigators. Microscopic details had at that time added immensely to our knowledge of the structure of this important organ, but since then pathological and physiological science has corrected many of the errors prevalent and improved our understanding of the localization of function.

When it was established that arm, leg, tongue, ear and eye centres were distributed about the brain cortex, beneath alleged bumps of conjugality, appetite for music, theology and onions, phrenology was discouraged except among its more ignorant devotees. At the conclusion of a popular lecture on the anatomy and physiology of the brain I was assailed by an itinerant phrenologist who did not relish his dollar-a-head prospects being jeopardized by the spread of my heresies. He offered to stake money on the infallibility of his "science" in a public demonstration, and when told that phrenology had been written up in a form available for criticism and

found to be defective, he warmed to the conclusion that he could lick any one who opposed phrenology with such "ipsy dixys."

Gall and Spurzheim are always cited by phrenologists as the founders of their system. While this is true, and it is also undoubted that they were in advance of the early part of this century in brain anatomy and philosophical guess work of brain functions, it is forgotten that but few anatomists of note have sustained the theories that have been piled upon the fairly well done work of a time when brain study was infantile. The ignorance of those who practice phrenology as an art, their illogicality, impudence and rapacity for fees, the fact that phrenology stands isolated from all the sciences, having nothing to do with physiology, chemistry, microscopy or pathology, as cerebrology has; its frequent defiance of exact knowledge which negatives the pretensions of bumpology, —all relegate phrenological claims to an equality with those of spiritualism, Christian science, jugglery and the multitude of penny-catching devices of an age of never-failing crops of knaves and fools. There is nothing like a good knowledge of physiology to destroy charlatanism and the superstition upon which it fattens.

But alchemy gave us some chemical facts, and astrology was mixed up with a few astronomical truths. Psychical research societies are trying to examine prestidigitation as one would study the mechanism of a watch through its key-hole, and it seems to me that patient study can be applied profitably to an examination of moribund old phrenology.

The tendency was extreme to locate pin-head points on the cranium that would reveal such things as whether one preferred coffee to tea; but, starting with the admission that there is a little truth in phrenology, in a general way, we are also confronted with the fact that, no matter how it is done, there has been some pretty shrewd guessing at character by even ignorant phrenologists. Their physiognomy studies are incomparably inferior to those of Darwin, or even those of the windy Lavater. Every one is an unconscious physiognomist without having analyzed expression; phrenologists make use of this common ability in estimating character. But this does not include their entire method, as they often hit off traits more happily than mere expression would enable them to do.

First of all let us glance at what is really known about heads

and their contents, and then see how much of phrenology can be adjusted thereto.

Prognathism and acuteness of Camper's angle are well-known indications of less intelligence. Apes also have less skull capacity with larger and more numerous ridges for muscle attachment.

The European has a characteristic medium (mesocephalic), rounder, oval or elliptical head, with no portion too prominent or flat, presenting more symmetry of contour, with oval face and full, expanded, elevated forehead. Want of symmetry, if marked, attends mental defect, but it has occurred in highly gifted men such as the French anatomist Bichat. No two heads are exactly alike any more than are two faces. The proportions existing between the front, middle and back parts of the head are of some value; departures from a width of eight and length of ten (mesocephalism), measured from one auricular aperture over the head to the other, and nose root over the head to the nucha, determine whether the skull shall be considered long, dolichocephalic, or broad, brachycephalic.

The front expanse is associated with a possible reasoning power, the back part with animality, but as this is necessary to force of character, a well-balanced head would be one that had a fair size of both parts. As the frontal bone is elevated the parietal must be raised to meet it. The artist Haydon, by cutting off this parietal raise, showed that the head was reduced from an intellectual to an animal appearance. Scaphocephalism, or a boat-shaped depression of the summit, occurs from defective parietal bone formation.

The Kalmucks incline to brachycephalism, while the negro is dolichocephalic, with prognathous jaw, large temporal and auricular muscles and low foreheads; the Esquimaux are tectocephalic (rafter-headed), with flat, pyramidal or lozenge-shaped faces, due to excessive zygoma projection, and narrow foreheads.

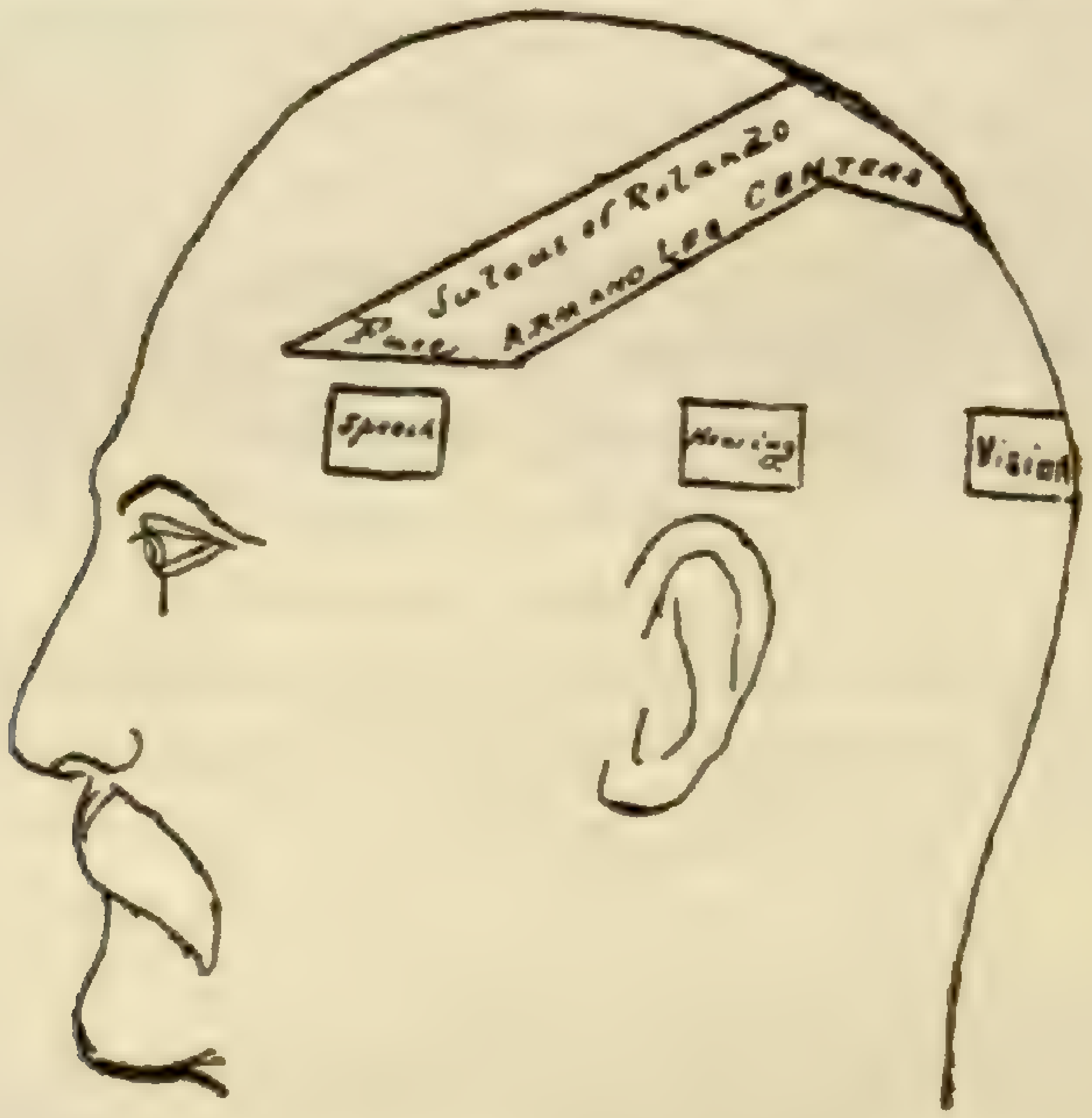
Carpenter notes that want, squalor and ignorance diminish the cranial and increase the facial size.

With increase of intelligence there is a larger brain mass in proportion to the muscular size, and also to the size of the spinal cord and peripheral nerves. I claim priority[1] in adopting the sulcus of

[1] Sulcus of Rolando and Intelligence. Written Feb., 1880. Journal of Nervous and Mental Disease, April, 1880.

Rolando as a means of estimating grades of intelligence in animals by the relative *masses* of brain parts it separated. Meynert[1] had, unknown to me, nearly simultaneously, stated that the angle at which the Rolandic departed from the Sylvian fissure was a measure, but in this he is in error, for that angle is *not* constant for species, while the relative proportions of fore and rear brain divided by the Rolandic sulcus maintain a just ratio to grades of intelligence, and the left sulcus summit should be farther back in the normal brain than the one upon the right side. I also claimed that the cerebellum was covered by the cerebrum in proportion as the frontal lobe developed and crowded the occipital portion backward. The forehead by this pressure is correspondingly expanded and lifted.

In the scale of higher intelligence the connecting commissures of the brain are more numerous, and the cortical gray matter is encroached upon by more cells and fibres. Convolutions are not necessarily more numerous, except where the cranium is relatively small and the soft brain tissue by rapid growth folds in to accommodate itself to the want of corresponding skull growth.



In accord with the results of earlier electrical experiments upon the bared brains of anthropoid apes, dogs and other animals, are the effects of disease limited to special parts of the brain of man,

[1] Archiv für Psychiatrie, vii.

more recently and thoroughly studied. We now know that there are centres in the brain of man for the speech faculty above the temple, and thence backward and upward to the upper back part of the head are arm and leg centres; auditory mental impressions being registered in the brain above the upper ear tip; a centre for visual function being in the occipital end of the cerebrum. The frontal brain is known to contribute to intellectual processes, for its injury degrades the character. This approximately sketches what has become positively known, and the illustration further assists the comprehension of these facts. The touch sense centres are distributed over the brain coincidentally, with motor centres for the same parts, *i.e.*, arm motor and sensory areas are in the same part of the brain.

Spaces intervening between the areas may readily be conceived to be filled with fibrils and cells that interrelate these and other functions complexly, the frontal portion compound complexly.

Sir Charles Bell remarked that "we ought to define the hand as belonging exclusively to man." Upon the increased dexterity in the use of fingers in the arts and sciences, which dexterity, in turn, develops brain centres, depends, largely, increased intelligence. Manipulation and vocal training enlarge the "symbolic field" of the brain (the speech, arm and leg centres before mentioned), situated along the sulcus of Rolando. Man is distinctively the symbolic animal, and whether these symbols are written, spoken or gesticulated, they serve purposes of intelligent intercourse, and upon this fact is based man's supremacy over other animals, and his higher faculties are superimposed thereupon.

When the portions of the brain allotted to control of body extremities are diseased, the dependent loss of function follows, but not necessarily involving mental loss; for example, if the injury is at the summit of the sulcus of Rolando, upon one side of the brain, the body is paralyzed upon the opposite side. The "blank spaces" between these centre areas afford debatable ground, for often injury in such parts has been followed by no discovered consequence. My opinion is that the effects have not been looked for in the proper direction; for, while destruction limited to these blank parts does not occasion loss of observable function (the arms, legs, speech may be unaffected), there will be found an attendant lowering of the

mentality in some or several directions, if thorough tests be made. What has been grouped under change of character should be sifted to ascertain what constitutes the change. If we grant, as we must, that all these function areas, ascertained to be such, are related, connected, by multitudes of strands and cells in the most complex manner over and across the blank spaces, then lesion of those spaces must interfere with the connections, the mental associations possible before cannot now be made. Occasionally "word deafness" or "word blindness" occurs, peculiar inability to connect words heard or read with any memory of their import, and, as could be expected, this impairment occurs when the lower parietal or "angular gyrus" region is the seat of the disease. While this consequence of injury to this part has been long known, I believe this to be the first announcement of the reason for it, and I will predict that the additional offices of this "blank area" will be established as noted below. "Arcuate" connecting fibrils enmesh the brain surface, uniting faculties intricately, in a manner obviously dependent upon the education and other circumstances of the individual. These fibrils and their generating cells may pile up in certain parts and be defective in others; the musician will have more connections between the auditory and motor centres, and the painter between the optic and motor, than others. One whose impulses or springs of action are well subordinated to what he has learned through optic, auditory or other senses, will have greater strands of connections between the sensory and motor brain parts to regulate his deeds than the impulsive or heedless person.

These blank spaces become what might be styled inhibitory regions, in that they restrain acts; they can also more properly be called impulse areas, because they regulate and prompt actions. As they correlate the sense and motor centres, they are also memory areas, as is evident when injury causes words to convey no meaning to the mind. Now, if what we see, feel and hear govern our actions, he who profits best by what he has been taught, or upon whom such teaching makes the best impression, will, *à priori*, have the most abundant supply of arcuate fibrils in this parietal region; such restraint or guidance unavoidably causes acts to be less impulsive, more subordinated to the interests of the individual. If those needs are considered to be best conserved by subservience to others

their approval will tend to regulate acts, a form of cautious deference dominates the person; if a wider, higher and better form of cautiousness, based upon what one considers his highest interests, his higher expediency ideals, whether with reference to this or another world, then the person is said to be conscientious. At this stage of analysis of what these inhibitory or impulse connections involved, I was astounded by recalling that phrenologists group "conscientiousness, approbativeness and cautiousness" in the identical place under discussion. The process of arriving at this discovery was by first recognizing inhibition to be but cautious control, and I have long held the idea that conscientiousness was but a higher caution.[1] Startled by noting that phrenologists place them next one another, as they assert, empirically, they having found these eminences to be prominent in persons who were thus scrupulous or guarded, I next observed that "approbativeness" is placed behind, but adjoining "caution and conscientiousness." This narration should acquit me of special pleading. Disposed unfavorably, as I was and am, against phrenology, as in the main a pseudo-science, my aim has been to unsparingly criticize it.

This group of alleged bumps in the position the phrenologists assign it is a remarkable coincidence, if it prove to be no more.

I prefer the designation *Impulse and Memory region* until more scientific men than phrenologists agree upon the separation of the area into the divisions, "cautiousness, conscientiousness and approbativeness," which cannot be done until we ascertain whether phrenologists lied, were mistaken, or were right in this particular.

"Firmness, Self-esteem, and Continuity" are placed by them over the tonsure or earliest bald spot, beneath which in the brain is the summit of the Rolandic sulcus, injury to which invariably causes paralysis of the opposite side. We can concede that an abundance of arm and leg centres in this region would indicate the possession of self-reliance, nor would it be far-fetched to interpret such control as firmness, scoring another for phrenology; an excess of this might be construed into self-esteem, and if the motor area (as in fact it does sometimes) extend farther occipitally, then this brain centre increase of cells and fibrils serving for better innervation of arms, legs and other parts, might be allowed to constitute

[1] Comparative Physiology and Psychology. A. C. McClurg & Co., 1884.

"continuity" in enabling more prolonged effort. Coincidences that may be justified by a real relationship. *Quien sabe?*

Below and toward the front is "Hope." If thought has its main seat in the frontal region, a prolongation of fibrils thence to control acts with a definite expectation in view, anticipation based upon reason, might justify some such bump as this, and in about that location. "Ideality" seems better placed, farther forward, for a similar reason, and not open to the objection of being located over arm and leg centres, as is "Hope," although arcuate fibrils having many destinations may overlie any part of the brain.

"Benevolence" is placed near or over the anterior fontanelle. As this trait is the outgrowth of sympathy, an acute feeling for others depending upon a thoughtful correlation of past experiences or impressions inherited or acquired, so there *may* be such a swelling in that vicinity.

"Constructiveness" is over the third frontal convolution root, which, on the left side, is the demonstrated seat of language, so the bump is mislocated. A rounding out of the side head above and forward of this could indicate the possession of such a faculty, because it depends upon ingenuity, mechanical ability, etc., a brain and mental breadth.

"Eventuality, Comparison, Causality, Individuality," in the frontal apices, apparently appropriately enough, for cerebral reasons.

The claim that "Amativeness" resides in the cerebellum has been sufficiently disproved by the experiments recorded in Carpenter's *Physiology*, where the cerebrum, and not the cerebellum, decreased in size with sexual loss. Furthermore, the cerebellum has no relation whatever to the posterior protrusion of the skull. A large muscular development is an indication of animality, which may be offset by intellectual balancing. Large trapezius and sterno-cleido-mastoid muscles would have a correspondingly large occipital ridge, and it is over this that the phrenologists locate "Amativeness."

The animal propensities, "Combativeness, Secretiveness, Destructiveness, Alimentiveness and Acquisitiveness" are suggestively gathered over the temporal and auricular muscles, as these muscles are large in rapacious animals. Without admitting the spe-

cial divisions, these animal traits undoubtedly could accompany extra prominence of these muscles in the place assigned to these faculties by the phrenologists, while there is not a cerebral or cranial warrant for the location, palpably when beneath this muscular swelling the skull is often depressed to afford it attachment. "Alimentiveness" is appropriately placed over the temporo-maxillary articulation; a great eater works this vicinity more, and thus may increase its size.

The superciliary ridge may be enlarged by serviceable and associated habit in shielding the eye, frowning while trying to perceive better, and thus indicate perceptive acuteness, but the subdivisions into size, color, etc., require demonstration, as extremely doubtful.

"Form" is said to be shown by width between the eyes. I know good artists who have not this width, and execrable ones who have it. Language does not produce œdema of the lower eye-lids; the faculty is remotely and surely situated under the alleged "Constructiveness."

It would not be profitable to discuss the other bumps, as they seem rather absurd.

We thus alight upon three main character indications, due to brain, skull or muscle prominences, which the phrenologists erroneously call cranial, and regard the brain as the cause of the skull elevations.

Thus, for cerebral reasons, there seems to be a plausibility in the location of

Firmness, Self-esteem, Continuity. Possibly justified by the underlying motor centres for the arm and leg. Cerebral control of the body.

Cautiousness, Conscientiousness, Approbativeness. Inhibitory faculties situated over spaces between rearward brain centres.

Benevolence, Hope, Ideality, Constructiveness. Inhibitory or impulse faculties between motor and intellect centres.

Causality, Comparison, Eventuality, Individuality. Intellectual faculties of the fore brain, internuncial fibrils relating other brain parts, correlating impulse areas.

For muscular and cranial reasons there is justification for the grouping of

Combativeness, Destructiveness, Secretiveness, Acquisitiveness, Alimentiveness. Animal traits that can be grouped under Ferocity, accompanied with large-sized temporal and auricular muscles.

Amativeness. Animality, with large neck muscles, occipital ridge and mastoid process.

Perceptives. In proportion to size of eye-brow ridge.

The remaining half of the phrenological faculties appear wholly or nearly wholly, unjustified.

Divested of the less plausible alleged faculties, the remaining ones, when subjected to the crucial test of Herbert Spencer's classifications of the feelings and cognitions, stand the scrutiny quite well, for the presentative feelings can be assigned to the cortical centres for sight, etc., and the impulse areas will include from behind forward the presentative-representative or emotions, the representative as "sublimity," and re-representative such as acquisitiveness, which might tempt us to take the latter out of the temporal muscle and allow it the position assigned by the phrenologists as cerebral. The cognitions similarly classified end in the highest of all, being placed in the apex of the frontal lobe, the re-representative cognitions, aggregations of representations, the appreciation of the general relations of things.

There is something beside generalizations in phrenology hidden beneath a load of trash. In shoveling this away scientific men are apt to jeer the labor; they can be as mulish as the most ignorant in refusing to see what they do not want to know; they are human, as witness the reluctance with which the majority accepted Darwinism, though emanating from a reputable source.

It should not be forgotten that phrenology was founded by good anatomists, and that scientists turned against it because charlatans built error upon it; but quacks have taught us a few things worth knowing.

OBSERVATIONS MADE IN THE CENTRAL PHILIPPINES.

BY J. B. STEERE.

THE islands of Panay, Guimaras, Cebu and Bojol may well be grouped together and called the Central Philippines. They are geographically connected; their people are of allied races and language, and, as we found, they are closely allied zoologically. With Mindanao on the south, Palawan on the west, Masbate and Mindoro on the north, and Leyte and Samar on the east, they are separated from all these by broad straits, while the channels dividing them among themselves are at their narrowest points nowhere more than five or six miles of continuous sea, and this usually shallow and apparently rapidly changing hues, so that the land areas must have been very different in size and form at a very recent period.

We arrived at the end of December, 1887, at Ilo Ilo, the capital of Panay, and the principal trade centre of the surrounding islands. Soon after we moved over to a pleasant native house on the island of Guimaras opposite. The place was on the beach, at the foot of some steep cliffs of coral, a little brook came tumbling down at one side, while a fine grove of cocoa palms shaded the house. The woods were near, and beautiful sun birds and Dicæums were flying about the palm houses, while several of the most beautiful species of the famed Philippine tree shells were found in abundance on the barn door and other outhouses near by. We were near enough the city to get a supply of fresh meat and bread every morning, and it was the nearest a naturalist's paradise we had yet found. The birds as they came in, though of genera we had already become familiar with in the west and south, were most of them of different species, showing that we had reached a new and distinct area.

The west side of the island is made up of steep, rugged cliffs of limestone, which rise up from two to three hundred feet above the sea. The rock has weathered into crevices and holes, leaving

sharp points standing up, which makes transit very difficult. Inland this rock is broken up by narrow, steep valleys, through which flow the little streams from the centre of the island. The cliffs are full of caves, which seem in most cases to be water courses cut through the rock. We had heard of nests of the edible swallow (swift) in the island, and finally found a wrinkled old Indian who made a living by gathering the nests and selling to the Chinese at Ilo Ilo. The nests are not found, as might be supposed, in those caves opening near the sea, but in those far inland, where the cavity is covered with forest. We went to the nest-gatherer's hut, two or three miles back from the sea, and telling him our object, he provided himself with a torch of native gum (dammar) and another made of the ribs of cocoa palm leaves, and we set out. After half an hour's rapid tramping through the steep, rocky valleys, we came to a low ledge of rock, eight or ten feet high, covered with vines and bushes, and at the foot of this a black hole three or four feet square, leading down into the earth. The opening was just large enough to crawl through, but our guide lighted his torches, and getting down on hands and knees crawled in, and we followed, down a steep, narrow, rocky passage, the channel of a stream in the rainy season. It widened and grew higher as we went down, but was still nothing more than a rift made in the rocks, perhaps by earthquake, and widened by water wear. The rocks were muddy and slippery, and we followed our barefooted guide with difficulty. Still on we went, until all trace of light except from our torches was gone, and it seemed anything but a fitting place for birds' nests. Still we went on, until after we were perhaps a hundred feet below the surface, and several hundred from the mouth of the cave, we began to hear the weak, faint twittering of the little birds as they flew about over our heads, and finally the Indian raised his torch, and we could see in the roof of the cave shallow hollows in the rock, and in these, and partly supported by their sides, the little white, cup-like nests, which the guide began tearing out with his fingers, and stuffing into a pouch at his belt. The birds fluttered about almost in our faces, but he kept on until he had gathered all in sight. None of them had eggs in them, as he had visited the place but two or three weeks before. The nests were pure white in color, made of little fibres interwoven

with each other, and were still soft and damp. How the birds had ever found this place so far from the light, with a dry face of rock, and with suitable digression in it was a wonder, and how they could do this work of nest building in such utter darkness. Coming to the surface we set out again, and after an hour's tramp came to the second cave. This time as we were making our way down a steep, timbered valley, the path all at once dropped out before us, and we were at the mouth of a dark well, leading down almost perpendicularly for twenty or thirty feet at first, when the descent became more gradual. By clinging to the projecting rocks we clambered down, and soon found ourselves in a passage twenty feet high and as many broad. Great masses of rock had fallen from the roof, which made our progress slow. Curious stalactite growths, taking the form of flat plates with saw-tooth edges, were hanging from the roof. After making our way to a still greater depth and distance than before, we again heard the faint noise of the birds, not loud enough to be heard except in such perfect quiet as we were in. It seemed more like the sounds spirits might make than the notes of anything earthly. Soon after we came to a part of the cave where the roof was some eight or ten feet high, and worn into curious and very regular pits, five or six inches deep and as many wide at the mouth, and as smooth and round as if made artificially. In these the birds were building their nests, attaching them to the walls of the pits. Again, in spite of the weak protests of the owners, the nests were torn out and appropriated by our guide.

As we made our way out we passed a stalactitic column a foot in diameter, which had connected the roof and floor of the cave, but had been broken across by earthquake, and the ends separated by half an inch. The thought of being caught away in there in utter darkness by an earthquake, with the rocks grinding and shutting in upon us, was anything but pleasant. Near the mouth of the cave, just where we could begin to perceive a ray of light from the surface, were several nests of cruder, rougher make, being much larger and made chiefly of grass and lichens stuck into the face of the rocks by large masses of the edible gum. The birds are, without doubt, of the same species. The guide said they were sentinels to alarm those within, and that their nests were always

built in that way. The birds are quite abundant in the island, and there are probably many caves which the old man has not yet found. He is said to be the only one who dares enter them, others being deterred by stories of snakes, which are not all stories, for we passed, near the mouth of the second cave, the cast-skin of a snake eight or ten feet in length. There are also stories of a curious little black, hairy people, the Kama Kama, which are invisible at most times, and which inhabit these caves and live on the snails with which the island abounds. The guide pointed out great heaps of empty shells, far in the caves, as proofs of the existence of the Kama Kama, but they looked like shells which had been floated in by high water.

The edible nest (swift) according to the guide, whose account was proved to be correct by our observations as far as they went, nests the year round, lays two small, white eggs, is about a month completing its nest, lays the eggs on the bird edible material of the nest, nests time after time in the same nest, adding to it each time. The young build beside the nest in which they were born, frequently attaching their nest to that of the parents.

The only forest remaining in Guimaras was in the rough gorges and upon the rocky cliffs near the sea, the upper level of the interior of the island being sandy, and much of it in cultivation to sweet potatoes and Indian corn, and in the lower places to rice. The hills of Panay, all about Ilo Ilo, and as far up the mountains as we could see, showed no virgin forest, but only grassy slopes and bushy ravines, a poor outlook for our work. Whether the same conditions have worked like results elsewhere or not, there can be no doubt that the Indian method of cultivation has produced these grassy plains from an anciently heavily timbered country. They cultivate by cutting down the timber and burning it during the dry season, and then planting on the burned and blackened ground. One or two crops are raised before the wild growth gets too strong for their large knives, their only implement of cultivation, and then the timber grows again from the roots and sprouts left in the ground, and the cultivator cuts off another piece of forest. After a few years, if the population is thick enough to demand it, the first piece, now grown up to brushwood twelve or fifteen feet

high, is again cut and burned and planted, and so on over and over again, the tree growth becoming weaker each time, until the coarse grass (cogon) gets in, and with it the annual fires, and then there is an end to Indian cultivation, and where were once tall forests, grassy plains take their place. This process can be seen on any island of the Philippines in all its stages. In some places the people are trying to overcome the cogon with the poor Chinese plows and the buffalo, but it is a slow way, and most of them prefer to move on to the forests again. By this means the central islands, which are the most thickly peopled, have become for the most part covered with grass, while the more sparsely settled islands of the west and south remain in forest.

[TO BE CONCLUDED.]

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GENERAL NOTES.

GEOGRAPHY AND TRAVEL.[1]

Asia, Etc.—Suanetia.—The first article in the June issue of the *Proceedings* Royal Geographical Society is that of Mr. Douglas Freshfield upon Suanetia, which is the Anglicized name of the upper basin of the Ingur, a small river which flows into the Black Sea a few miles east of Sukhum Kaleh. The valley is about forty miles long by twenty wide, and lies between three and four thousand feet above the sea. On its north lie the complicated ridges of the crest of the Caucasus, with such summits as Tetnuld (15,947 feet), Koshtan–tau (17,036 feet), and Ushba. These ridges are composed of crystalline rocks, which show the tendency observable in the Alps to arrange their summits in double lines, in the troughs between which lie vast névés. The great glacier basins thus enclosed are named the Zanner, Thuber, Gvalda, and Betsho. These glaciers send down to the Ingur or its tributaries many ice-streams, such as the Adish, which in the Alps would rank as a first-class glacier. On either flank of the rigid granites lie beds of friable schists, whose summits present green rounded outlines, and exhibit a striking contrast to the snowy precipices of the great chain. South of Suanetia rises the lofty slate ridge of the Leila, which runs parallel to the main chain, and attains elevations of 12,000 feet. At its western end this ridge bears some considerable glaciers. The river escapes from the valley at its western end, between high spurs of the two chains, and through a narrow porphyritic gorge not at present passable for horses. To the east the valley of Suanetia terminates in a low grassy down (8,600 feet), only 1,600 feet above the highest villages, and beyond this lies a pathless waste of forests and flowers—the wilderness in which rises the Skenes Skali, a tributary of the Rion (the ancient Phasis). But this outlet is so circuitous that both Russians and natives have preferred the higher and steeper Latpari Pass (9,200 feet), which is the usual route into the valley.

The natives of this secluded spot are first mentioned by Strabo under the name of Soani, and the received text credits them with 200,000 fighting men. Strabo says that the king had a council of 300, and that the tribe used poisoned arrows in war. Whatever the former strength of the nation, the Suaneti, as they now call themselves, did not number more than 12,000 at the last census.

[1] Edited by W. N. Lockington, Philadelphia, Pa.

Over one-third of these live on the upper Skenes Skali, and are more or less merged with the surrounding Mingrelian populations. The Suanetians are not in the odor of sanctity. At best they are sheep-stealers and cattle-lifters. They were converted to Christianity before the tenth century, but may now be fairly described as reverted pagans. Seven hundred years ago Suanetia formed part of the kingdom of the famous Georgian Queen Thamara, in whose honor the Suanetians still chant ballads. For awhile it was connected with Mingrelia, but at some time in the last century it became entirely unattached, and the upper part of the Ingur valley still bears the name of Free Suanetia. The country is covered with small chapels, dating probably from the 11th and 12th centuries, but these are no longer used as churches, but as treasure-houses. Long before Suanetia had obtained home rule, it had disestablished its church. An hereditary caste of local elders took the place of the priests, and a village vestry assumed the control of the ecclesiastical property and kept the keys of the church, which contain many curious and some beautiful works of art. Services and sacraments followed the priests. Marriage consisted in sewing together the garments of the bride and bridegroom, and the ancient funeral ceremonies were revived. There are traces of tree-worship and also of that of the heavenly bodies. The natural tendency of the population to increase beyond the supporting powers of the territory was effectually checked by placing a pinch of ashes in the mouth of every superfluous female baby. Russia assumed suzerainty over this district in 1833, and has gradually tightened her sway, appointing headmen or *starchinas* in every commune, and establishing several schools, as well as placing its representative at Betsho in a position to command some respect and obedience. The Suaneti are rather a farming than a pastoral people, though they keep a few flocks of sheep and herds of horses. There does not seem to be a prevalent type among the people. There are fair men with tawny beards, dark men, men that look like Persians and men that resemble figures from an Assyrian monument. The criminal refugees that have for centuries found a sure retreat in this mountain Alsatia have so obscured the traces of the original stock that it is difficult to tell whether that stock was Georgian or Colchian. Mr. Freshfield, on account of the resemblance of the Suanetian tongue to the Early Georgian, accepts the former view.

The architecture of the Suanetian villages is striking. Towers and castles abound. Mestia has seventy towers forty to seventy feet high; Ushkul about fifty and two castles. The towers, constructed for defence, are of untrimmed black slate, and are attached to houses built of the same material.

The Solomon Islands.—The Solomons lie about five hundred miles east of New Guinea, and extend for six hundred miles northwest and southeast, between the meridians of 154° and 163° E. longitude, and the parallels of 5° and 11° S. latitude. They were discovered and named by the Spaniard Mendana, in 1567. There are seven principal islands (Bougainville, Choiseul, Ysabel, Malayta, San Christoval, Guadalcanar, New Georgia) and several smaller ones. The total area of the group is estimated by Mr. C. M. Woodford, who has recently returned from a lengthened residence among them, at 15,000 square miles, but they may still be considered as to a great extent unknown. Dr. Guppy, who has recently written a valuable work entitled "The Solomon Islands; their Geology, general Features, and suitability for Colonization" was attached to a man-of-war, but Mr. Woodford resided among the natives, engaged in collecting birds, mammals, etc., and was thus exposed to many dangers among a people who are given to head-hunting and cannibalism. The island of Savo was an active volcano when discovered in 1567, and at the present time has hot springs, which also occur upon Simbo and Vella Lavella, while Kulambangara is an extinct volcano. There is an active volcano near the centre of Bougainville. On this island, which is the largest and most northerly of the group, the mountains rise to a height of 10,000 feet, on Guadalcanar to 8,000 feet, and on the other large islands to from three to five thousand feet. The islands are mostly clothed with dense tropical forest from the coast to the mountain tops. Records kept by traders at Ugi and Santa Anna show that the annual rainfall is from 100 to 150 inches per annum. Mr. Woodford stayed awhile upon the islands of Alu, Fauro, New Georgia and Guadalcanar, on the last of which he lived half a year. Here he explored the rivers Aola and Kobua, and got a bearing of the peak Vatapusau (4,360 feet).

The natives are mostly of the Papuan type, with some admixture of the lighter Polynesian. The men wear no clothes save the T bandage so common among savage races, and many do not even wear this. On San Christoval and Malayta the women have a plaited square of grass fibre about six inches by four suspended round the waist, but some go absolutely naked. On Guadalcanar the females are invested in a series of superposed fringes. Many of the natives pierce the lobe of the ear, and enlarge the opening till it attains a diameter of two inches or more. The canoes vary in size from one just large enough to carry a boy of twelve to the great head-hunting canoes, capable of carrying fifty or sixty men. They are adzed down from the solid tree, sewn together with a tough vegetable fibre, and caulked with a putty scraped from the kernel of the nut of *Parinarium laurinum*. The use of stone implements seems to have gone out, except perhaps on Bougainville,

a plane-iron being now employed to serve as the blade of an adze. On Savo the megapode or mound-builder lays its eggs upon two sandy patches of open ground, and nowhere else on the island. These laying-grounds are fenced off into small divisions for various owners. In New Georgia and the adjacent smaller islands the passion for head-hunting is such that no canoe can be launched without a head being obtained. The chief hunting grounds are the large islands of Choiseul and Ysabel, which have been nearly depopulated by the practice.

GODWIN-AUSTEN PEAK.—The second highest mountain known to exist on the earth's surface is as yet unnamed, unless the letters K 2, by which it was characterized by the surveyors who discovered and fixed its position nearly thirty years ago, can be called a name. Attention to this unnamed and unknown condition of the second mightiest elevation of the world, 28,250 feet above the sea-level, was called through the reading of Lieutenant Younghusband's account of his adventurous passage over the Mustakh Pass on his way from China to India. General J. T. Walker (late Surveyor-General of India), has proposed that the peak be named Godwin-Austen, after the first surveyor of the Mustakh ranges and glaciers, and the proposition received the assent of the meeting of the Royal Geographical Society.

A route practicable for road or rail has been found from Assam to Upper Burma, across a belt of dense tree jungle and mountain, which lies between the last British station in Assam and the summit of the Patkoi range.

AFRICA.—THE CAMEROONS.—M. Valdau, a Swedish colonist of the Cameroons, explored the northern slopes of the range in the early part of 1887, and found that the main chain does not extend as far as 4°30′ N. Latitude, since the highest point attained by him, about 4°28′ N. Latitude, only measured 2,850 feet. M. Knutson, another Swede, in July last discovered the mouth of the river Memeh, which had previously been supposed either to be a tributary of the Rio del Rey, or of the Rumbi. Its embouchure is a little to the south of that of the Rumbi. M. Knutson ascended the river, which he found to be navigable for about thirty miles, as far as the Düben Falls, 100 feet in height.

SENEGAMBIA.—French explorers and surveyors have been busy in Senegambia. The country of Bondu, hitherto known only from the itineraries of Mungo Park and others, has been thoroughly surveyed by M. Fortin and Leforte; and the district of Bambuk, which two years ago was the least known part of French Sudan,

has been completely surveyed by a large party of officers. This region occupies the territory between the Faleme, Senegal, Bafing, and the country of Konkadugu, but its population is only 20,000. The divide between the Senegal and the Gambia was explored by the military columns which operated against the Marabout Mahmadu Lamine. It consists of undulating plains of small elevation, with stony patches at intervals, and contains five small confederated states, with a population of about 13,000. South of Bambuk Captain Oberdorf has explored the Upper Gambia to 12° S. Latitude, and also the upper courses of the Faleme and the Bafing, two important tributaries of the Senegal. Existing maps, especially as regards the Faleme, will have to be considerably altered. This river does not rise in the plateau of Timbo, but in the Koy Mountains. The Tene, hitherto regarded as the upper course of the Faleme, is an affluent of the Bafing. The large tributaries of the Senegal have some fine open reaches, but their navigability is prevented by frequent rapids and falls. Captain Oberdorf concluded treaties with all the tribes visited, save those of Koy. Lieutenant Reichemberg visited Konkadugu, Bafe, Solu, and the left bank of the Bafing. Valuable auriferous bearings are reported from the first of these districts. Captain Peroz, whose mission was directed southeast of that of Captain Oberdorf, surveyed the valley of the Milo as far as Bissandugu, and also the Bure and Upper Bafing, but the chief result of his efforts was the conclusion of a treaty with Almany Samory, by means of which the French possessions are extended to the banks of the Niger and the Tankisso, and the French protectorate to the confines of Liberia. Lieutenant Quinquandon and Dr. Tautain, who were sent to visit Great Beledugu and the left bank of the Niger, visited Murdia, Gumba, Segala, and Sokoto, and report that the soil becomes less and less fertile towards the northeast, where the country is analogous to Southern Algeria.

Europe.—Three Days on the Summit of Mont Blanc.—A party of French meteorologists spent three days of July, 1887, on the summit of Mont Blanc. They were accompanied in the ascent by twenty-four bearers, of whom all but two deposited their burdens upon the summit and immediately departed. In the ascent of the last hill, M. M. Vallot and Richard were attacked by mountain sickness and did not recover for several hours. In a small indentation between the dome of the summit and the ridge by which it is reached the observers pitched their tent. During the first night M. Vallot attempted to fix the instruments, but was driven back by the wind and snow. During the next day he was more successful. While on the summit the health of the party was not very good, yet numerous physiological and meteorological observations were made. On July 30th a terrible thunder storm raged around them for several hours.

THE GERMAN POPULATION.—M. Ch. Grad (*Revue Scientifique*, April 14th, 1888), gives the number of German-speaking people within Germany itself at 41,512,000, and the entire German-speaking population of Europe at 60,000,000. To make up this total we have 8,000,000 in Austro-Hungary, 1,900,000 Swiss, 860,000 Russian Germans (625,000 of whom are Jews), 4,270,000 Hollanders and Luxemburgers, 3,400,000 Flemings (300,000 of whom are in France), and 30,000 Germans resident in Belgium. The number of Germans in Europe has doubled since 1820, in spite of the emigration. The 3,722,000 non-German speaking individuals enumerated at the last census by no means represents the actual extent of the Slavic element, since the whole course of the history in the provinces east of the Elbe has been one of Germanization of an originally Slavic population.

THORODDSEN'S EXPLORATIONS IN ICELAND.—M. Thoroddsen has contributed to Petermann's *Mitteilungen* an account of his exploration of the northwestern peninsula of Iceland in 1886. This part of Iceland forms a table land, averaging rather more than 2,000 feet in height and broken up by fjords the sides of which are almost perpendicular. Nearly every fjord has distinct terraces representing ancient coast lines, now high above the sea. Banks of shells identical with those now living in the sea, and skeletons of wha! and walrus have been discovered in these terraces. The Glamujokull glacier, which once measured 120 square miles, has shrunk to half its former size, while one of the glaciers of the Drangajökull has also shrunk from sixty to thirty square miles. From measurements made from the end of the Reykjarfjord glacier, the traveler found that it had retreated 1,600 yards during the last fifty years. From Furuffjord to the North Cape the coast is formed by a stretch of basaltic rock, 1,300 to 1,600 feet high, traversed by deeply eroded grassy valleys, some of which are inhabited. The dwellers in these valleys live principally by catching sea birds. The Horn Mountain (North Cape), is the highest resting-place in Iceland.

A DISCOVERY IN THE ARCTIC OCEAN.—According to the organ of the Geographical Society of Stockholm, Captain Johannesen last summer succeeded in reaching an island, situated to the east of Spitzbergen, in 80°10′ N. Latitude, and 32°3′ E. Longitude. This island is a table-land rising to 2,100 feet, and is supposed to be the same as Hvide O, seen by Captain Kjeldsen, and also by Captain Sorensen on August 28th, 1884. This discovery confirms the existence of an archipelago extending from Spitzbergen to Franz Josef Land, preventing the ice from descending into the Barents Sea, and thus having a great influence over the climate of Europe.

GEOLOGY AND PALÆONTOLOGY.

ROMANOVSKY'S MATERIALEN ZUR GEOLOGIE VON TURKESTAN.—Scattered notes of the geology of Central Asia have from time to time been given in these pages, but M. Emm. de Margerie's *Compte-rendu de publications relatives à la Géologie de l'Asie et de l'Amérique* now gives us the opportunity to give a fuller account. MM. Mushketoff and Romanovsky, after having explored with great thoroughness the possessions of Russia in Central Asia, have published a part of their results. The first volume of M. Mushketoff's orographical and geological description of Turkestan appeared in 1886, while the first number of M. Romanovsky's *Materialen zur Geologie von Turkestan* was issued in 1880. M. Mushketoff considers the natural limits of Turkestan to be as follows: the Mougodjar mountains and the plateau of Ust-Urt to the west; the Tsungarian Ala-tau, the chains of the Tian-shan and the Pamir to the east; the Kopet-dagh and the mountains of Khorassan to the south; and the Tarbatagai, Zenghis-tau and the watershed between the Aral and the affluents of the Irtish to the north. The space comprised within these boundaries consists of two unequal parts, separated by the crest of the Kara-tau: the northern part, about one-third of the total area, corresponds to the basins of Lake Balkash and of other smaller lakes, while the larger southern part forms the Turan or basin of the Aral. The latter is divided by the Nura-tau into two portions: the basins of the Syr-daria and of the Amu-daria, the latter twice the size of the former. The reliefs of Turkestan pass from the N. E.—S. W. direction to that of N. W.—S. E. by insensible gradations, so that they form bundles of folds having their convexity turned towards the south, as in the chains of northern India. There are three principal groups of folds, the Tarbatagai, the summits of which do not pass 2500 metres; the Tian-shan in the centre, with summits reaching 5000 metres, and even 7300; and in the south the Pamir with a central crest reaching 4500 to 5000 metres, and with some summits of even 8000. Notwithstanding the diversity of the rocks that enter into its constitution, the Turanian basin presents a monotonous and but slightly varied geological structure, since Cretaceous, Tertiary, and post-tertiary deposits cover ninety-five per cent. of the surface, the older formations appearing only as masses here and there piercing the uniform mantle of modern sediments. Above the Palæozoic rocks, with a very noticeable uncomformity, lies a series of deposits with fossil plants, evidently a prolongation of the plant-bearing series of Afghanistan, and of the Gondwana group of Hindostan. During the Jurassic period the Turan formed a great island, extending far to the east, where scattered lagoons received

sediments of small thickness; these sediments accumulated along the southern coast of the emerged land, but, as in Afghanistan, cover only a comparatively small area. Beds of lignite are abundant in the lower parts of the Trias-jura, as, for example, on the flanks of the Kara-tau and all around the Fergana basin, and in the absence of the true coal-measures, may prove of economical importance. The Jurassic is conformably covered by the Cretaceous and Tertiary beds, which reach a thickness of 650 metres in Fergana, and even 1600 in Hissar. These two series are so intimately linked that it is impossible to fix a precise line of demarcation between them, and both alike have been affected by dislocations which are well-marked near the mountains, but die out in the centre. The Cretaceous series comprehends very varied rocks, those of the plains differing much from those of the Tian-shan, where they consist chiefly of marls and limestones, the latter often shelly, but becoming oolitic and compact more to the east; the marls often enclose gypsum. It is in Fergana that the Cretaceous presents the greatest diversity of faces, but as fossils are rare and in poor condition, it is difficult to separate the series into stages.

General.—The Geological Structure of Afghanistan.—M. Griesbach, Geologist of the Afghan Boundary Commission, has at various times published in the Records of the Geological Survey of India preliminary notes upon the geological structure of those portions of Afghanistan visited by him. These facts have been brought together by M. de Margerie in his *Compte-rendu de Publications relatives à la Géologie de l'Asie et de l'Amérique,* in such a manner as to give what appears a tolerably clear picture of the geological structure of this mountainous country. The principal crest of Afghanistan is formed by the Hindu-Kush and the Koh-i-Baba, the latter of which is continued into Persia, by chains running to the northwest. Although the greater part of the country is as yet geologically unexplored, the researches of M. Griesbach are sufficient to afford a good index to the character of the remainder. It thus appears that the palæozoic and older mesozoic rocks only come to the surface on the line of the main axis, the rest of the country being occupied mainly by cretaceous beds, often unconformable to the older mesozoic beds upon which they repose. Extensive surfaces in the north and west are covered by tertiary deposits. The region between the main chain of Afghanistan and the next most important series of elevations, viz., that which runs parallel to the Indus, is occupied by a number of anticlinal folds, crowded together in the region of Cabul, but spreading outwards fan-like as they approach the frontier of Persia. Most of the rivers found their present courses in miocene times, since which they have eroded deep ravines, while in the meantime the great anticlinal folds have be-

come more accentuated. North of the main axis lie a series of parallel folds, narrow and lofty near the centre, but gradually spreading as they recede from it until they become broad and low undulations. The geological structure of Persia seems to be a continuation of that of Afghanistan. The oldest fossiliferous deposits as yet known belong to the Carboniferous system. Wherever examined, the Carboniferous outcrops are, like all the great bands extending from Armenia to the Himalaya, of marine origin. Above the Carboniferous beds lie a number of conformable deposits composed of marine beds alternating with littoral and fresh-water layers enclosing lignite and abundant remains of terrestrial plants. The exact classification of these beds has not yet been attempted, but they are surmounted conformably by undoubted Neocomian deposits, and their lower schistose portion is regarded by M. Griesbach as representing the Permian and Lower Trias; while Jurassic fossils have been discovered in the upper part. Great eruptive activity seems to have characterized the end of this series of littoral beds.

PALÆOZOIC.—E. N. S. Ringueberg (*Amer. Geol.*, May, 1888) gives reasons for considering the Niagara Transition Group as nearer to the Niagara than to the Clinton which underlies it, this affinity being determined by the increased number of Niagara molluscs found in it. The Niagara shales themselves can, upon palæontological evidence, be divided into three parts, each characterized by a regular upward decrease of the fossils. The lower third contains, with very few exceptions, all the species to be found throughout the entire group. A few valves of *Orthis lynx* have been found in the lowest third. The close of this lowest third is marked by a band characterized by the small crinoid *Homocrinus parvus*. *Hemicystites parasiticus*, parasitic upon *Spirifera niagarensis*, has not been found elsewhere by the author of the paper. The second and third divisions are chiefly defined by negative evidence, yet Homalonatus reaches its maximum size after leaving the Homocrinus band, and the few specimens of Cornulites and Stomatopora are mostly from within its borders, as is also the case with *Tentaculites niagarensis* and *Beyrichia spinosa* and *B. symmetrica*, which trio extends into the upper third. In the upper third corals are scarce, cephalopods almost entirely wanting, and crinoids excessively rare. *Rhynchonella neglecta* and *Streptorhynchus subplanum* are two of the most constant fossils, which attain their best development in this division.

Cœlosteus ferox is the name given by Prof. Newberry to a large species of fish, apparently allied to Dendrodus and Rhizodus, of which the jaws, teeth and bones were discovered in the Lower

Carboniferous Limestone at Alton, Ill. The lower jaw is about a foot long, an inch and a half wide in front, and widens to four inches behind. It is marked on the upper margin by a series of broad, shallow pits, for the insertion of few but large teeth. The jaws, as well as a large bone, probably a coracoid, consist of a thin shell of bone, enclosing a large area, which was doubtless occupied by cartilage. The dentary differs from that of Rhizodus in being entire.

Titanichthys clarkii Newb., discovered by Dr. W. Clark near Berea, O., exceeds in size even the *T. agassizii* of which drawings were exhibited at the meeting of the American Association at Montreal, 1882. The broadly triangular cranium measures five feet or more between the posterior lateral angles. It is concave behind, and the central part of the arch is marked by a broad depression as in Dinichthys. The condyle of the post-temporal bone is horizontal and broad, and is clasped in a furrow at the angle of the cranium. The post-temporals are a foot and a half wide, and, as in Dinichthys, are overlapped by the clavicles below and by the dorso-median plate above. This plate is sub-circular, and has a long, slender, furrowed process projecting backward and downward. The sub-orbital bones are eighteen inches long, the mandibles three feet. The posterior end of the mandible is spatulate, six inches wide, and turned upward; the anterior end is turned up like a sled-runner, and is excavated by a deep furrow somewhat as in *T. agassizii*, but the whole jaw is much heavier and broader. The under side of the body was protected by a triangular plate three feet long and nearly as broad, having a deep sinus posteriorly and a rounded projecting angle near the middle of either side.

MESOZOIC.—Mr. A. S. Woodward (*Quart. Jour. Geol. Soc.*, May, 1888) describes *Semionotus capensis* and *Cleithrolepis extoni*, both from the Stormberg Beds (Early Mesozoic) of the Orange Free State. The only species of Cleithrolepis before described, is *C. granulatus*, from the supposed Triassic Hawkesbury Beds of New South Wales. The South African specimens afford sufficient data to prove that the genus must be placed with the Dapediidæ.

A. Weithofer describes in the *Annals of the Naturhistorischen Hofmuseum of Vienna*, a new Dicynodont (*Dicynodon simocephalus*) from the Karroo formation of South Africa. The specimen is unfortunately only an imperfect half of the cranium, lacking the lower jaw, yet it offers characters which distinguish it from the species described by Owen. The parietal region is very highly developed, rising eleven centimetres, or more, above the line con-

necting the mastoid and the frontal, whereas in *D. pardiceps* Owen it only rises 5.5 cm. over the same level. The frontals are less developed than in *D. leonticeps*, the orbits are deeply sunk, and the nasal openings are placed far forward, so that it is one of the most peculiar representatives of the group. The entire occipital region and the bones of the under side are wanting.

J. S. Newberry (*Trans. N. Y. Acad. Sci.*, 1887) gives an account of the fauna and flora of the Trias of New Jersey and the Connecticut valley. About a hundred kinds of tracks of reptiles and amphibians have been found on the layers of sand which at one time fringed the triassic estuaries. These impressions vary from an inch to nearly two feet in length, and are for the most part three-toed, but in some cases are four- and five-toed. Alternating with the barren red sandstones and shales are some layers of dove-colored shale, which contain much organic matter, a few impressions of plants (of which thirteen species have been identified), and large numbers of the remains of fishes. All but two of the plants have been found in the Trias of Virginia and North Carolina. Prof. Fontaine has shown that the plants of the Richmond basin have greater affinity with those of the Rhaetic beds of Europe than with those of any other horizon, and has inferred that the southern extension of our Triassic rocks hold the same position in the geological scale.

The fishes of our Triassic strata belong to six genera, viz., Diplurus (1 sp.), Ischypterus (18 sp.), Catopterus (5 sp.), Ptycholepis (1 sp.), Acentrophorus (1 sp.) and Dictyopyge (1 sp.). Of these *Diplurus longicaudatus* Newb. was a large Cœlacanth, reaching a length of three feet, and is closely allied to Holophagus Egt., of the English Lias.

All the species are distinct from any known in the Old World, but a species of Ptycholepsis allied to ours is found in the Lias of Boll, Wurtemburg, and a species of Dictyopyge has been described from the Keuper of Germany. Catopterus seems to be distinct from any genus of fossil fishes found in the Old World, but Ischypterus is very near to Semionotus Ag., which is represented by species in both the Lias and Trias of Europe. Acentrophorus Traq. seems to differ from Ischypterus only in the absence of the spiny scales along the dorsal line. *A. chicopensis* is named from the Chicopee Falls, Mass., where it is found.

Geo. F. Becker (*Bull. Cal. Acad. Sci.*) replies to Messrs. Hague and Iddings' criticisms upon his conclusions respecting the pyroxenic rocks of Washoe. The former geologist sees in these rocks evidences of two separate eruptions, and therefore divides them into diabase and andesite, while the latter geologists consider both

of these masses as substantially a single Tertiary eruption. Mr. Becker claims to have found additional reasons for maintaining the existence of diabase, and also for dividing the pyroxene andesite into two distinct outflows, separated by a long interval of time. At Steamboat Springs, about six miles from Virginia City, occurs an extensive series of sedimentary beds, nearly vertical, with a strike following the general direction of the Sierra. Andesites and basalts have broken through and overlie these beds, which are without trace of fossils, and are evidently pre-tertiary. Indeed, they appear to be as old as the rocks determined as Jura-Trias by the geologists of the fortieth parallel. These sedimentary beds contain pebbles of the exact character, both physically and mineralogically, with the east wall of the Comstock lode, determined by Becker as porphyritic diabase. The presence of these pebbles in beds of pre-tertiary age proves that there must be real pre-tertiary diabase somewhere in the neighborhood of Mt. Davidson. This locality is substantially in the same district as the Comstock lode, and, according to Mr. Becker's investigation of the faulting action on the Comstock, formerly received the drainage from the diabase area at Virginia.

The first number of Band xxxiv. of *Palæontographica* contains a description of some fossil remains of Chimæridæ in the Museum of Munich. These remains comprise some species of Ischyodus previously known, and also *Ischyodus ferrugineus*, nov. sp., and *Edaphodon kelheimensis*, nov. sp., as well as *Chimæropsis paradoxa* Zittel.

In the thirty-fourth part of *Palæontographica*, E. Holzapfel describes the molluscs of the Cretaceous of Aachen, prefacing his account with descriptions of the strata and lists of the species contained in each.

Dr. Rust (*Palæontographica*, Band xxxiv.) adds an important contribution, illustrated with eight plates, to the knowledge of the Radiolaria of the Cretaceous. Whilst in the Jura the oldest and newest beds are richer than the middle, in the Cretaceous the oldest stages are the richest. The Neocomian and Gault are especially rich. Out of a total of 165 species described in Dr. Rust's monograph, 59 are found in the Neocomian, 109 in the Gault, and only six in the upper stages of the system.

Cænozoic.—Prof. J. Prestwich (*Quart. Jour. Geol. Soc.*) gives a table of the accepted classification of the Eocene series in England, Belgium, and the Paris basin, and states his reasons for some adverse conclusions. The sands and marls of Heers (Bel-

gium) are usually considered as a separate horizon, but Prof. Prestwich points out that there is nothing in their molluscan fauna to warrant them as older than the Landenian, while the presence of sixty-two plants, all but one new and peculiar to the locality, may be simply due to the proximity of land. He objects also to the correlation of the Sables de Bracheux with the Lower Landenian and Thanet Sands, pointing that out of the eighty-two species of mollusca found in the Bracheux Sands only six seem to be common to the Thanet Sands and five to the Lower Landenian, while ten are found in the Woolwich beds. A table gives Prof. Prestwich's views upon these and other points in the correlation of these important beds of the London, Belgian and Parisian basins.

A. Weithofer has recently described several species of bats from the phosphorites of the central plateau of France, including Pseudorhinolophus, sp., *Alastor heliophigas.*, nov. gen. and sp., *Rhinolophus dubius,* Vespertiliavus, sp., Taphozous, sp., *Neoremantis adichaster,* nov. gen. and sp. Fossil Cheiroptera, like fossil birds, are rare.

A. Gaudry and Mar-Boule, in their third fascicule of *Matériaux pour l'histoire des temps Quartenaires,* call attention to the destruction of forests which resulted from the sands, clays and rocks brought down by the glaciers, forming a soil without vegetable humus, which even now is with difficulty made productive. What the moraines spared the cold completed, so that only herbage and shrubs could grow upon a soil which, as in the Siberian tundra, was frozen even during the summer at a certain depth. To meet this change in the character of the vegetation the type of the Rhinoceros was gradually modified into that of the Elasmotherium, which may be characterized as an intensely herbivorous Rhinoceros. The cranium of the Elasmotherium is larger than that of *Rhinoceros tichorhinus,* the example in the Museum of Paris measuring 98 centimetres in total length. The sinus of the frontal bones is developed into an enormous rugose protuberance, which probably supported a huge horn. The parietals take no part in the composition of this prominence, but are forced back by it, and are very much reduced. The nostrils are completely separated by a septum, and the nasals are narrow and smooth, showing that they did not bear a horn, as was the case in *R. tichorhinus.* The extremity of the intermaxillaries is largely developed, indicating the presence either of a proboscis, as in the tapir, or, as believed by our authors, of a prehensile lip. The twenty molars of Elasmotherium have longer crowns, and are much more complexly folded than those of any rhinoceros.

BOTANY.[1]

The Flora of Palestine.—A general opinion seems to prevail, even among those who have visited the country, that though flowers are abundant in Palestine, especially during and immediately succeeding the rainy season, yet the number of species is remarkably small. This idea as to the paucity of species is scarcely correct. The multiplicity of species, and the large variety of peculiar forms are, in fact, in many cases, noticeable features of the flora.

As an example, I may state that I have collected, in the immediate vicinity of Jerusalem, eleven species of *Geranium*, including the *G. tuberosum*, that very distinct species with tuberous root. In this group, as in most others, the differentiation of the species is remarkably pronounced, being displayed not only in the form, color, number, furnishing and disposition of the blossoms, but also being exhibited in the great variation of the leaf, and even sometimes, as in the case of the species mentioned, passing into the character of the root.

I have had my attention attracted by the great number of cruciferous plants, as also those of a prickly or thorny nature. Indeed, genera whose species in other countries are usually smooth and unarmed, are here represented by species having prickly, spinous, or thorny appendages. It may be considered significant that in this land, where the great event (the central thought of Christianity) occurred, the plants should be found so frequently bearing the cross and wearing the thorns.

The number of garden plants which here grow wild has been commented on. To-day, I found on the rocky hills around Jerusalem the Narcissus and the Scarlet Anemone, Cyclamens, and the little blue-gray Iris, all in blossom. The Narcissus as well as Almond had been in flower for more than two weeks, and the Crocus and Orange for months; the fruit of the latter (confined to gardens) having been ripe since November. The Asphodels were pushing up their long stalks, heavy with buds, from among their spear-like leaves; and the purple Bugloss (*Echium violaceum*) hung from the cliffs. The very rocks seemed breaking out into blossom and praise.

In northern Palestine, in the months of March and April, after the effect of the rainy season has been felt, the bursting of the land into flower is a sight never to be forgotten. I have ridden on horseback, hour after hour, day after day, through miles of Scarlet Anemones and Ranunculus, Lupine, Scabious and Pheasant's-eye. Patches of vividly red Poppies, with fine black maculations, like eyes, edged with white, made matchless streaks of color. The

[1] Edited by Prof. Chas. E. Bessey, Lincoln, Neb.

purple Gladiolus sent up its graceful spires in the fields, and along the roadside trailed with great crimson bells the *Convolvulus jalapa*, and the smaller belled white *Convolvulus* with pale sulphur-colored rays. To see the Tulips (*Tulipa gesneriana*) breaking out of the hard dry soil of the very pathway, was a wonder, recalling the well-remembered description in Isaiah: "The wilderness and the solitary place shall be glad for them; and the desert shall rejoice and blossom as the rose." No artist, not even Turner himself, could do justice to the glorious colors of the landscape.—HENRY GILLMAN, *U. S. Consul, Jerusalem, Palestine, February 10th, 1888.*

THE ENTOMOPHTHOREÆ OF THE UNITED STATES.—These parasitic plants have been studied by Roland Thaxter, who has embodied his results in a monograph published in the Memoirs of the Boston Society of Natural History, Vol. IV., No. 6, bearing date of April, 1888. The order is now known to be a Zygophyte, related to the Mucorini, instead of Oöphyte with close relationship to the Saprolegniaceæ. This Thaxter confirms by his beautiful drawings of Zygospores, produced by a true conjugation.

The twenty-eight species described are arranged under three genera, viz.: Empusa, Massospora, and Basidiobolus. The name Empusa, proposed by Cohn in 1855, is very properly adopted in place of Entomophthoreæ, proposed by Fresenius in 1856. Sixteen new species are described, all of which belong to the genus Empusa. A synopsis, with hosts, as follows, may be of value to collectors and students:—

1. *Empusa muscæ* Cohn.—"Diptera: *Musca domestica, Lucilia cæsar, Calliphora vomitoria*, and other large flies; also Syrphidæ of several genera."
2. *Empusa culicis* A. Braun.—"Diptera: Imagines of Culex and numerous genera of minute flies or gnats."
3. *Empusa grylli* (Fresenius) Nowakowski.—(*Entomophthora aulicæ* Reich. and *Entomophthora calopteni* Bessey.) "Lepidoptera: Larvæ of many genera of Avatians and of *Orgyia nova*. Orthoptera: Larvæ, pupæ, and imagines of many genera of Acidians. Imago of Ceuthophilus. (?) Diptera: Larvæ and imagos of Tipulidæ, etc."
4. *Empusa tenthredinis* (Fresenius) Thaxter.—"Hymenoptera: Larvæ of Tenthredinidæ."
5. *Empusa conglomerata* (Gorokin) [?] Thaxter.—"Diptera: Larvæ and imagines of Tipulæ."
6. *Empusa apiculata* Thaxter.—"Lepidoptera: Larva of *Hyphantria textor*, imagines of Fortrix sp., Deltoid sp., Petrophora sp. (Geometrid). Diptera: Numerous genera of small flies or gnats. Hemiptera: Imago of a species of leaf-hopper (Typhlocyba)."

—— Var. *major* Thaxter.—" Coleoptera: Imago of *Ptilodactyla serricollis.*"

7. *Empusa planchoniana* (Cornu) [?] Thaxter.—" Hemiptera: Several genera of Aphides."
8. *Empusa papillata* Thaxter.—" Diptera: Several minute gnats."
9. *Empusa caroliniana* Thaxter.—" Diptera: Imagines of Tipula sp."
10. *Empusa fresenii* Nowakowski.—" Hemiptera: *Aphis mali* and very many other aphides."
11. *Empusa lageniformis* Thaxter.—" Hemiptera: Usually aphides on *Betula populifolia.*"
12. *Empusa lampyridæum* Thaxter.—" Coleoptera: Imago of *Chauliognathus pensylvanicus.*"
13. *Empusa geometralis* Thaxter.—" Lepidoptera: Imagines of geometrid moths (Petrophora, Eupithecia, Thera, etc.)."
14. *Empusa occidentalis* Thaxter.—" Hemiptera: Aphides on *Betula populifolia.*"
15. *Empusa sphærospermia* (Fres.) Thaxter (*E. radicans* Brifeld, *Entomophthora phytonomi* Arthur).—" Lepidoptera: Imago of *Colias philodice;* larva of Pieris. Hymenoptera: Ichneumonidæ of several genera and species, a small bee (near Halictus). Diptera: Imago of *Musca domestica*, Musca sp.; numerous small species belonging to the Culicidæ, Mycetophilidæ, Tipulidæ, and other families. Coleoptera: Larva of *Phytonomus punctatus;* imago of one of the Lampyridæ. Hemiptera: Aphis sp.; several species of Typhlocyba (leaf-hoppers), larvæ, pupæ, and imagines. Neuroptera: Imago of Limnophilus. Thripidæ: Larvæ, pupæ, and imagines of a species of Thrips on Solidago."
16. *Empusa aphidis* Hoffman.—" Hemiptera: Aphides of numerous genera."
17. *Empusa depterigena* Thaxter.—" Diptera: Small Tipulæ; other small flies or gnats, belonging especially to the Mycetophilidæ."
18. *Empusa virescens* Thaxter.—" Lepidoptera. Larvæ of *Agnotis fennica.*"
19. *Empusa americana* Thaxter.—" Diptera: *Musca domestica, M. vomitoria, Lucilia cæsar*, and numerous other large flies."
20. *Empusa montana* Thaxter.—" Diptera: A minute gnat, apparently Chironomous sp."
21. *Empusa echinospora* Thaxter.—" Diptera: Imago of *Spromyza longipennis*, and (rarely) other smaller Diplisa."
22. *Empusa sepulchralis* Thaxter.—" Diptera: Imagines of Tipulidæ."
23. *Empusa variabilis* Thaxter.—" Diptera: Minute gnats of various genera."

24. *Empusa rhizospora* Thaxter.—"Neuroptera: Several genera of Phryganeidæ (imagines)."
25. *Empusa gracilis* Thaxter.—"Diptera: On very minute gnats."
26. *Empusa conica* Nowakowski.—"Diptera: Imagines of Chironomus and other small gnats."
27. *Massospora cicadina* Peck.—"Hemiptera: Larvæ, pupæ, and imagines of *Cicada septendecem*."
28. *Basidiobolus ranarum* Eidam.—"On the excrement of frogs."

Collectors may be able to add to the species given above. As Mr. Thaxter desires to continue the investigation of the Entomogenous plants of North America, he desires correspondence upon this subject, with specimens in quantity. He should be addressed at New Haven, Conn. This little group ought now to receive a considerable attention at the hands of our botanists.—*Charles E. Bessey.*

A MINIATURE TUMBLE-WEED.—On the great plains of Nebraska, from the altitude of two thousand five hundred to three thousand feet above sea-level, to and throughout the Rocky Mountain region there grows the very pretty little aster-like plant known as *Townsendia sericea* Hook. It blooms in early spring, and its pretty, almost sessile, heads of numerous flowers nearly cover the plant itself, so that one sees little more than a compound rosette of yellow and delicate pink close upon the ground.

After blossoming, the bracts of the involucer remain for a considerable time widely opened, but when the achenes are ripe the involucer closes and forces out the mass of achenes, with their abundant long, white pappus and effete corolla tubes. This expulsion was observed

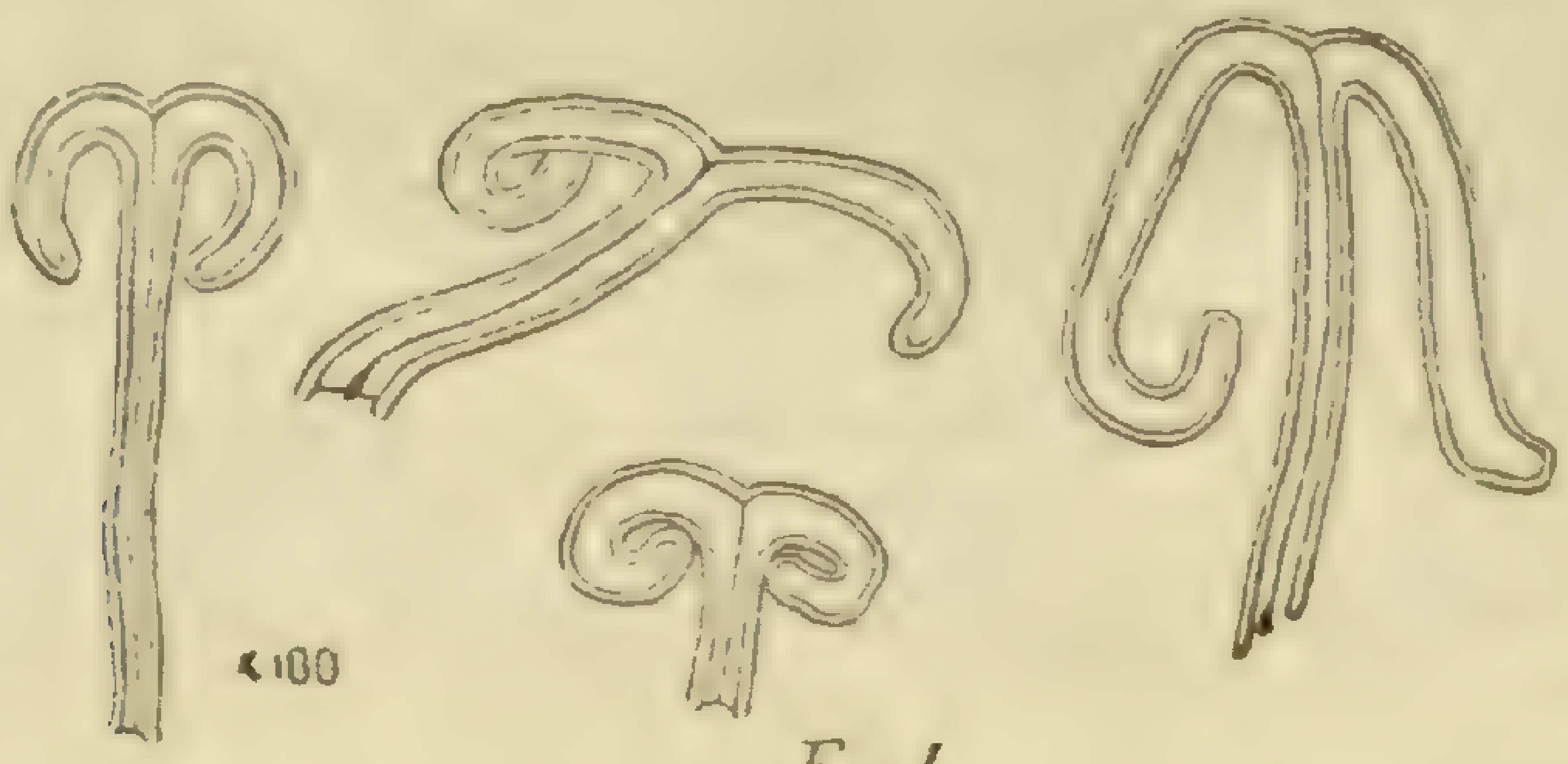


Fig. 1

to take place, in one instance, in a plant grown in my laboratory with such force as to suddenly throw the mass of achenes and pappus out free from the involucer. I suppose that the spreading of the pappus has also much to do with freeing the achenial mass from the involucers. Possibly the pappus and involucers act together.

The achenes are pretty well covered with long twisted and bent "duplex" hairs, as is common in this and many allied genera.[1]

[1] As shown by Professor Macloskie, in his paper on "Achenial Hairs and Fibres of Compositæ." American Naturalist, Vol. XVII., p. 31; and also "Achenial Hairs of Townsendia." Ibid., p. 1102.

The extremities of the hairs are recurved into double hooks, as shown in the accompanying cut (Fig. 1). The body of the hair (as shown by Macloskie) is composed of two parallel, greatly-elongated cells, each of which is recurved, thus forming the double hook. In some instances I have observed septa in one or other of the cells, although for the most part they are wanting. The hairs upon each achene become interwoven with those of neighboring achenes, and, upon drying and twisting, they firmly bind together all the achenes of each head. The spreading pappus forces the mass to take an ellipsoid form as soon as it has escaped from the involucer (as shown in Fig. 2). Lying now upon the surface of the plant, and entirely freed from the embrace of the involucer, the light mass is ready to begin its career as a miniature "tumble-weed." After a few rolls it loses most of the effet ecorolla tubes and tumbles lightly along upon the points of its spreading pappus.

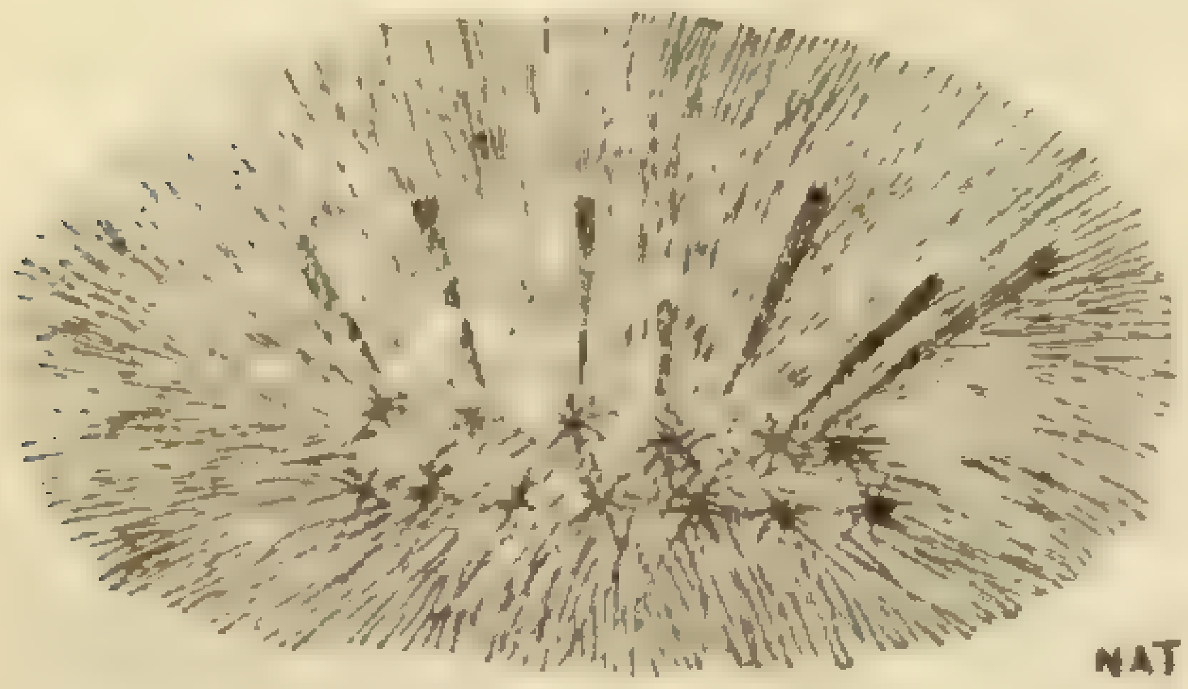

NAT SIZE

Fig. 2.

The jarring gradually separates the tumbling ball; but even when it breaks in two, each part rounds up again by the wide spreading of the pappus and rolls on again before the brisk breeze of the plains, dropping here and there an achene with its hidden seed, just as the great tumble-weeds, Amaranthus, Cycloloma, Corispermum, etc., do in their larger way.—*Charles E. Bessey.*

Underwood's Ferns and their Allies.[1]—This little book, the first and second editions of which were noted in the Naturalist at the time of their appearance, has been entirely re-written; and while the general plan of the former editions has not been materially modified, the details have undergone very considerable changes. The present edition contains thirty-four pages more of matter than the last, and this increase is divided between the general matter (which gains nineteen pages) and the systematic portion, which is increased fifteen pages.

This increase in the number of pages is due to the new matter introduced in the general part, consisting mainly of excellent references to the literature of the subject, and in the systematic part to a considerable increase in the number of species. The glossary is also much increased in volume and value.

The book is a most useful and handy one, and will enable the student of the Pteridophytes to obtain an excellent idea of their structure and classification.

[1] Our Native Ferns and Their Allies, with Synoptical Descriptions of the American Pteridophyta north of Mexico. By Lucien M. Underwood, Ph.D., Professor of Biology in Syracuse University. Third Edition, revised. New York: Henry Holt & Co., 1888. 16mo, pp. xi., 156.

We regret that the author did not abandon the term frond, which our present knowledge of the comparative anatomy of plants ought to soon render obsolete. *Frond* and *stipe* ought not to be tolerated longer; we should say *leaf* and *petiole;* for a "frond" is only a leaf and a "stipe" is only a petiole.

In the chapter on "The Fern's Place in Nature," the author adopts the term Spermaphyta for the flowering plants, and gives an excellent list of systematic works for the different classes of the vegetable kingdom.—*Charles E. Bessey.*

ZOOLOGY.

American Nematognathi.—The peculiar connection between the air-bladder and hearing apparatus of the Nematognathi has received considerable attention from comparative anatomists. Cetopsis, the families Argeidæ, Loricariidæ, Callichthyidæ, and Hypophthalmidæ were said by Johannes Müller and by Valenciennes to be destitute of an air-bladder, and consequently of the auditory ossicles. Reisner, Day, Sagemehl, and Wright have successively proved the presence of an air-bladder encased in bone in all the forms except Cetopsis. In connection with a Revision of the South American Nematognathi we have examined Cetopsis, and have also made observations on the Loricariidæ, Callichthyidæ, Hypophthalmidæ, Siluridæ, Pygidiidæ, and Bunocephalidæ. Cetopsis agrees in general with the Pygidiidæ (=Trichomyteridæ). The enclosure of the air-bladder in a bony capsule in the Nematognathi of America instead of being the exception is the rule, modifications of the enclosed air-bladder being the case in all the families but the Siluridæ and Bunocephalidæ (=Aspredinidæ).

A hint as to the method by which the air-bladder was enclosed may be detected by a comparison of Ageneiosus and Hypophthalmus. In Hypophthalmus the air-bladder is half bony, half membranaceous, the bony portion being attached to the modified vertebræ; the whole air-bladder is surrounded above and behind by the lateral processes of the modified vertebræ, below partly by lateral processes of the vertebræ, mostly by the processes connecting the scapula with the basioccipital, anteriorly partly by the expanded scapula. The scapular process in Hypophthalmus extends from the basioccipital backward and outward. If now the coalesced vertebræ could be lengthened so as to separate the scapular process from the lateral processes almost the exact conditions would be obtained which are found in Ageneiosus. Like Hypophthalmus,

the air-bladder of Ageneiosus has a bony base, the membranaceous portion being restricted to a membrane stretched across the opening of the bony capsule; the whole air-bladder is likewise surrounded above and behind by the lateral processes of the modified vertebræ and anteriorly partly by the scapula, but the coalesced vertebræ are much longer than in Hypophthalmus, and the lateral processes and scapular process are widely separate below.

Many changes in the classification of the Nematognathi have been found necessary. The Bunocephalidæ (=Aspredinidæ) usually associated with the Loricariidæ have no skeletal affinities with that family, being much more nearly related to the Siluridæ. The genus Cetopsis, as before stated, is more closely related to the species of Pygidiidæ (=Trichomycteridæ) than to the species of Doradinæ, with which it has usually been associated. The genera Heptapterus and Nannoglaris, on the contrary, are closely related to some of the species of Günther's Pimelodus, and have no real affinity with the Pygidiidæ.

Perhaps the most interesting of the South American cat-fishes is *Diplomystes papillosus*, Cuv. and Val. It differs from all other cat-fishes in having *a well-developed maxillary bone* bearing a band of teeth and forming the sides of the jaw. This species has no barbels excepting one short one on each maxillary. It is nearly related to Tachisurus Lacépède (=Arius), and in many ways represents a primitive fish; it may be the remnant of the parent cat-fishes formerly distributed more widely over South America, but now crowded by the more specialized forms, out of the waters inhabited by them to Chili, where it has to contend with the species of Pygidium only.

The relationships of the American families may be seen from the following key:—

(*a*) Air-bladder simple or with transverse constrictions (except in Ageneiosus) lying free in the abdominal cavity. Mouth terminal; intestines short, arranged in longitudinal folds. Body naked or with a single series of lateral plates; diaphragm membranaceous; dorsal fin short; confined to the abdominal portion of the vertebral column.

(*b*) Opercle none; adipose fin none; neural spines of the coalesced vertebræ forming a ridge from the occipital to the dorsal fin. Caudal vertebræ greatly compressed; their neural spines expanded. .... *Bunocephalidæ.*

(*bb*) Opercle well developed and movable; adipose fin normally present; occipital process sometimes forming a bony bridge from occipital to the dorsal plate. Caudal vertebræ normal; the neural spines spine-like...*Siluridæ.*

(*aa*) Air-bladder rudimentary; one on either side of the coalesced vertebræ, and entirely surrounded by a bony capsule.

(*c*) Air-bladder capsule formed by the scapula, the process connecting the scapula with the basioccipital and by the lateral processes of the coalesced vertebræ, its external opening bounded by the scapula and lateral processes; adipose fin small; dorsal fin on anterior half of body, over anal; anal long.......*Hypophthalmidæ.*

(*cc*) Air-bladder capsule formed by the lateral processes of the anterior vertebræ only. No adipose fin; dorsal fin usually on caudal portion of vertebral column; anal short..........*Pygidiidæ.*

(*ccc*) Air-bladder capsule formed by the skull and transverse processes of anterior vertebræ; diaphragm partly or wholly osseous, formed by the expansion of the clavicle and scapular process. Scapula and its process firmly joined to the skull; gill membranes joined to the isthmus.

(*d*) Derm naked; mouth inferior; lower lip reverted; teeth bicuspid, in several series........ ....*Argeidæ*

(*dd*) Derm with bony plates.

(*e*) Caudal vertebral compressed, the neural and hæmal spines expanded, forming a continuous ridge above and below. Sides with several series of plates; mouth inferior; lower lip reverted; teeth turned abruptly back above, a single series erect, the intermaxillaries and dentaries box-shaped, filled with numerous depressed relay teeth; intestinal canal coiled. Cavity of air-bladder usually communicating with the exterior at a notch in the posterior margin of temporal plate at beginning of lateral line..........*Loricariidæ.*

(*ee*) Caudal vertebræ normal, the neural and hæmal spines spine-like and separate. Sides with two series of plates; mouth terminal; lower lip not reverted; teeth villiform; cavity of air-bladder communicating with the exterior by means of a long narrow slit in the temporal plate.................................. ......*Callichthyidæ.*

—*C. and R. Eigenmann.* (*Mus. Compar. Zoölogy, Cambridge, Mass.*)

Description of a New Red-backed Mouse (Evotomys dawsoni) from the Headwaters of Liard River, North-west Territory.—Dr. George M. Dawson, Assistant Director of the Geological and Natural History Survey of Canada, has kindly sent me for determination a red-backed mouse collected by him June 23d, 1887 at Finlayson River, one of the northern sources of Liard River, in lat. 61° 30′ N.; long. 129 30°′ W.; altitude, 3,000 feet.

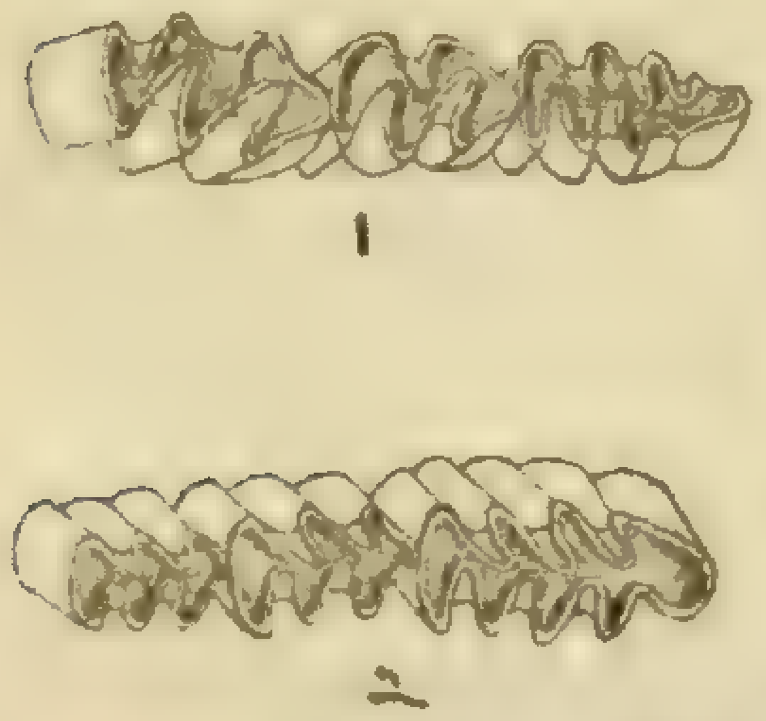
So little is known of the small mammals of this remote and inaccessible region that it is not particularly surprising to find that the mouse collected by Dr. Dawson proves to be undescribed. In some respects it is intermediate between the circumpolar *Evotomys rutilus* and its more southern congener, *Evotomys gapperi.* But since it differs from both and no intermediate forms are known, it must

be regarded as specifically distinct. Hereafter, should intergrades be discovered, it may be necessary to consider it a sub-species. It may be characterized as follows:—

Evotomys dawsoni sp. nov.

Dawson's Red-backed Mouse.

Type in Museum of Geological and Natural History Survey of Canada, at Ottawa. From Finlayson River, a northern source of Liard River, N. W. T. (lat. 61° 30′ N.; long. 129° 30′ W.; altitude, 3,000 feet). Size, about equal to that of *Evotomys gapperi.* Measurements from mounted specimen (apparently well mounted and not at all stretched): Head and body, 75 mm.; tail vertebræ, 28 mm.—pencil, 8 mm. (total, 36 mm.); ears, from crown, 7 mm. Tail shorter and thicker than in *gapperi,* but longer and slimmer than in *rutilus,* in this respect (but no other) agreeing with a specimen collected at Fort Liard by Kennicott (No. 4,562, U. S. National Museum). The hind foot is intermediate between that of *rutilus* and that of *gapperi,* being thicker than in *gapperi,* but not so thick as in *rutilus.* The ears conspicuously overtop the fur, fully equalling those of gapperi. The tail is bicolor, the yellowish of the under part occupying a little more than half of the circumference. It is well haired, and the terminal pencil is nearly black above (and 8 mm. long). The red dorsal stripe begins just behind the eyes and extends to the root of the tail. In color it is bright chestnut—not far from ferruginous; the sides are tawny gray, and the belly is strongly washed with ochraceous buff. The admixture of black-tipped hairs is as great as in *gapperi* and it is very much more conspicuous, owing to the lighter ground-color of the back and sides. The result is a sort of "peppery" appearance not seen in any other representative of the genus. There is a tolerably well-defined whitish post-auricular spot—an exaggeration of the pale blotch sometimes seen behind the ear in *rutilus.* The whiskers are black and white; they reach back to the shoulders, instead of stopping at the occiput, as usual in the genus. A blackish stripe, bordered below with fulvous, runs from the base of the whiskers to the tip of the nose. The projecting margin of the ear is well covered with reddish hairs, brightest on the interior of the auricle.



1

2

Molar teeth of *Evotomys dawsoni.* Merriam. 1, right upper molar series; 2, left lower molar series.

Cranial and Dental Characters. — Unfortunately, the skull was badly smashed and part of it altogether wanting; hence no cranial characters can be made out. The teeth, however, remain, and are represented in the accompanying cut. Their most marked peculiarity, compared with

those of *gapperi*, consists in the openly-communicating loops. The upper molar series measures 4.5 mm. on the crowns, 4.8 mm. on the alveolæ. The lower molar series measures 4.4 mm. on the crowns, 4.6 mm. on the alveolæ.

I take great pleasure in bestowing upon this handsome mouse the specific name *dawsoni*, as a slight recognition of the indefatigable zeal of its discoverer, the distinguished explorer and geologist, Dr. Geo. M. Dawson, who has added so much to the fund of knowledge relating to Northwestern Canada.—*C. Hart Merriam.*

Zoological News—General.—F. Koenike records (*Abh. Nat. Ver. Bremen.*, X.) the finding of the Myriapod *Geophilus sodalis* in a hen's egg.

Protozoa.—Dr. A. C. Stokes gives a generic synopsis of the sedimentary fresh-water peritrichous Infusoria in the *American Monthly Micros. Journal*, IX., p. 59.

Cœlenterates.—Dr. Benjamin Sharp records (*Proc. Acad. Nat. Sci.*, Phila., 1888, p. 82) the finding of the common ctenophore, *Mnemiopsis leidyi* in a pond of fresh water in Nantucket. They appeared perfectly healthy and active and were phosphorescent at night. The pond was occasionally opened to the sea to allow the escape of the perch which bred in it; but at the time of the observation the water in which the jelly-fish were swimming was perfectly fresh to the taste.

Worms.—Dr. Otto Seifert has a paper on the pathological effects of the human parasite, *Ankylostomum duodenale*, in the *Verhandlungen* of the Phys. Med. Gesellschaft, of Würzburg (XXI.). This is the worm which was first brought into prominence at the time of the building of the St. Gothard tunnel, when it produced the disease in the workmen known as Gothard or tunnel disease.

Molluscs.—Dr. W. D. Hartmann communicates to the *Proceedings* of the Philadelphia Academy (1888, pp. 14–56) catalogues of the known species of the genera Auriculella and Achatinella, of the Hawaiian Islands. The account of the latter genus is prefixed by a *résumé* of our knowledge of the individual variation and the local distribution of the species.

Mr. B. H. Wright describes (*Proc. Acad. Nat. Sci.*, Phila., 1888, p. 113) seven new species of Unionidæ from Florida. Each specific name is dedicated to some friend of the describer.

Dr. E. von Martens describes (*Stzb. Gesellsch. Naturf. Freunde*, Berlin, 1887, p. 106) two new species of Unio (*U. percompressus* and *U. microdon*, from Guatemala.

Crustacea.—Dr. A. Walter describes (*Bull. Soc. Imp. Nat.*, Moskau, 1887) two new phyllopods (*Apus hæckelii* and *Artemia asiatica*) from the Russian Transcaspian province.

The species of the genus Podon are reviewed by Poppe in the *Abhandl. Nat. Verein zu Bremen*, Bd. X. A new species (*P schmakeri*) is described from Shanghai, China.

C. F. Lutken has a paper on the whale-lice (Cyamus) in *Vidensk. Selsk. Skr. Kjobenhaven*, IV. He points out the identity of certain species described by Dall with those of previous authors, and re-describes, with a full-page plate, Dall's *Cyamus scammoni*.

Carl Bovallius, (notes on the family Asellidæ, communicated to the Royal Swedish Academy of Science, December 9th, 1885,) makes the family to consist of thirteen genera, three of which, Iamna, Iathrippa and Iais, are new. The two forms of Iamna were formerly referred to Iaera; Iathrippa is formed to receive *Janira longicauda*, while Iais includes the new species *I. hargeri* and the *Jaera pubescens* of Dana.

Arachnida.—Herr Doenitz describes (*Stzb. Gesellsch. Naturf. Freunde*, Berlin, 1887) the habits of two new trap-door spiders of Japan, belonging to the genera Atypus and Pachylomerus. *P. fragaria*, unlike the rest of the genus, excavates its tubes in the soft bark of the camphor-trees or of the cypress (Cryptomeria) and closes it with a door, which it carefully covers with moss like that covering the rest of the tree. Doenitz also describes (*l.c.*) the copulatory habits of a Japanese species of Linyphia.

S. A. Poppe communicates to the *Abhandlungen* (Band X.) of the Scientific Union of Bremen a valuable review of the parasitic mites belonging to the families Sarcoptidæ and Chelytidæ. The paper contains, among other things, a catalogue of all the known species of bird-mites (Analgesinæ), arranged according to hosts.

Joseph L. Hancock describes (*Proc. Am. Phil. Soc'y*, XXV., 107) a new species of Datames (*D. magna*) from Laredo, Tex.

Dr. H. C. McCook, in a recent visit to London, found the original drawings by John Abbott which formed the basis of Baron Walckenaer's descriptions of the American species of spiders. He gives the results of his studies of these drawings and the conflicts of priority of nomenclature between Hentz and Walckenaer in the *Proceedings* of the Philadelphia Academy (1887, p. 74).

Birds.—Mr. F. A. Lucas (*Auk*, V.) gives a historical sketch of Bird Rocks, in the Gulf of St. Lawrence, and describes a recent visit to the place.

Dr. Elliott Coues proposes (*Auk*, V., 207) the term Corydomorphæ for a super-family of birds, embracing the larks (Alaudidæ),

which is distinguished from the other passerine birds by the non-oscine scutelliplanlation.

Dr. R. W. Shufeldt continues his studies of the pterylosis of birds by describing the feather-tracts (*Auk*, V., 212) of certain of the woodpeckers.

From notes on the fauna of Corea, by H. H. *Giglioli* and T. Salvadori, as well as from a list of birds collected by M. Kalinowski, and described by L. Taczanowski (*P. Z. S.*, Dec., 1887), it appears that a close affinity exists between the Corean and Japanese faunas. The greatest rarity mentioned by the former authors is *Cyngus davidi*, of which two specimens were obtained. According to M. Kalinowski, Corea is very poor in birds, three-fourths of which are only birds of passage. Only one new species (*Thriponax kalinowskii*) is described, and three others were for the first time found on the Asiatic Continent.

Mr. P. L. Sclater describes (*P. Z. S.*, Jan., 1887) ten new species of Tyrannida from various parts of South America.

Mr. K. B. Sharpe (*P. Z. S.*, 1887) describes *Carpophaga whartoni*, a new species of fruit-pigeon from Christmas Island; also, from the same island, a thrush, whose nearest ally is a West African species.

Mammals.—The officers of H. M. S. Flying-Fish collected at Christmas Island, a coral island 190 miles from the nearest point of Java, two species of Mammalia, viz.: a new species of Flying-Fox (*Pteropus natalis*), and the large rat *Mus macleari*.

Although the true zebra is now a rare animal, it appears from a letter published in the *Field*, Dec., 1886, by Mr. H. A. Brydon, that it still inhabits the most remote and rugged ranges of Cape Colony, such as the Winterhoek Mountains and the Zwartberg.

W. H. Flower (*P. Z. S.*, Dec. 6th, 1887) denies the right to generic rank of the pigmy Hippopotamus of Liberia, asserting that the greater relative size of the brain cavity, orbits, and auditory bullæ in the Liberian animal, are similar in their nature to those which always occur between the large and small members of the same genus. The characters used to distinguish the genus Chorropsis, to which it is referred are, however, dental.

ENTOMOLOGY.[1]

Some Observations on the Mental Powers of Spiders.—Under this title an important memoire is published by George W. and Elizabeth G. Peckham,[2] in which these observers detail numerous experiments upon the senses and mental powers of spiders. The following extracts will serve to indicate the scope of these experiments, and some of the conclusions deduced from them.

"Our experiments on the senses of smell in spiders extended over two summers. Many of them were performed by each of us separately, that we might detect the mistakes of the other. Our usual plan was to hold a slender glass rod, eight inches in length, in such a position that one end closely approached the spider, noting what effect, if any, was produced, and then to dip it into whatever scent we were using, hold it in the same position, and again note the effect. We tested them in this way while at rest in the web, while stalking their prey, while feigning death, and under various other conditions.

"The scents used were essential oils, cologne, and several kinds of perfumes. Acetic acid, vinegar, and like materials were avoided on account of their irritating action upon the integument.

"To sum up our work on the sense of smell, we made, in all, two hundred and twenty experiments. We found three species (*Argyroepeira hortorum*, *Dolomedes tenebrosus*, and *Herpyllus ecclesiasticus*) that did not respond to the tests. In all other cases it was evident that the scent was perceived by the spiders. This they showed in different ways,—by various movements of the legs, palpi and abdomen, by shaking their webs, by running away, by seizing the rod and binding it up with web as they would an insect, and in case of the Attidæ, by approaching the rod with the first legs and palpi held erect; but whether in the way of attacking it, or, as it sometimes seemed, because the smell was pleasant to them, it is impossible to say."

The most successful experiments upon the sense of hearing were conducted with tuning-forks. "These show that certain spiders indicate that they hear a vibrating tuning-fork by characteristic movements of the legs. Another set of spiders, however, manifest their perception of the sound in a different way. With these

[1] This department is edited by Prof. J. H. Comstock, Cornell University, Ithaca, N. Y., to whom communications, books for notice, etc., should be sent.

[2] Journal of Morphology, Vol. I., No. 2, pp. 383–419; also published separately by Ginn & Co., Boston.

the approach of a vibrating fork seemed to cause a greater alarm, making them drop from the web and keep out of sight for a longer or shorter time. However, after one of these spiders had been subjected to the experiment several times, it would, instead of dropping, raise its legs in the manner described above.

"A few experiments were made to determine where the organ of hearing was located, but we can offer nothing positive on this question. It seems probable that the auditory apparatus is but little specialized. Possibly it is spread over a considerable portion of the epidermis.

"We endeavored to estimate the strength of the maternal feeling in our spiders by removing their cocoons and then noting with what degree of eagerness they sought to regain them; and also by determining for how long a time they would remember the cocoons if they were separated from them.

"Notwithstanding many efforts, we never found a spider among the Lycosidæ that was constant in her affection for so long a time as forty-eight hours. A female of *Clubiona pallens* Hentz, however, remembered her eggs for this length of time, and when they were returned to her spun a web over them in the corner of the box in which they were placed. Of all the spiders that we experimented upon, the little *Theridium globosum* Hentz had the best memory for her cocoon. We took her from her web, and returned her to it after fifty-one hours. She at once went to the eggs and touched them with her legs. She then left them, to improve her house, every now and then running back to see if they were safe. After she had arranged her household to her satisfaction she settled down near them.

"Several species of Attidæ and Thomisidæ did not remember their cocoons for twenty-four hours; yet these spiders, although they do not carry the egg-sack around with them, remain near it for from fifteen to twenty days."

As bearing on the sense of sight, they state: "We have frequently, while feeding our captives, seen them stalk their prey at a distance of five inches; and we have repeatedly held the active jumping-spider, *Astia vittata*, on one finger, and allowed it to jump on to a finger of the other hand, gradually increasing the distance up to eight inches. As the distance increased the spider paused longer before springing, gathering its legs together to make a good ready.

"We have twice seen a male of this species chasing a female upon a table covered with jars, books and boxes. The female would leap rapidly from one object to another, or would dart over the edge of a book or a box so as to be out of sight. In this position she would remain quiet for a few minutes, and then, creeping to the edge, would peer over to see if the male were still pursuing

her. If he happened not to be hidden she would seem to see him, even when ten or twelve inches away, and would quickly draw back; but in case he was hidden behind some object, she would hurry off, seeming to think she had a chance to escape.

"The male, in the meantime, frequently lost sight of the female. He would then mount to the top of the box or jar upon which he found himself, and, raising his head, would take a comprehensive view of the surrounding objects. Here he would remain until he caught sight of the female,—which he often did at a distance of at least ten inches,—when he would at once leap rapidly after her.

"The ocelli of some spiders, then, enable them to see objects at a distance of at least ten inches."

In order to determine whether spiders have a color sense or not, experiments were tried upon species that were found during the day, running among dead leaves, or hiding under stones or wood. Cages were constructed, each consisting in part of blue, green, yellow and red glass. Spiders were placed in these cages, and the color of the glass beneath which they retreated and remained was noted. The relative positions of the colors were varied on the different experiments. It was found that in two hundred and thirty-seven trials the spiders chose the red one hundred and eighty-one times, the yellow thirty-two, the blue eleven, and the green thirteen. These experiments seem to be conclusive as to the existence of a color sense in certain spiders.

We have not space to quote the results of experiments upon feigning death by spiders, nor to repeat the accounts of mistakes of spiders.

MEETING OF THE ENTOMOLOGICAL CLUB OF THE A. A. A. S.—The next meeting of this club will occur at 9 A.M., August 15th, in the High School building at Cleveland, Ohio.

Owing to the central position of Cleveland, this will be very convenient for the entomologists of both Canada and the United States. We may, therefore, expect a large attendance and a very interesting meeting.

Those who expect to furnish papers should send the titles at once to the Secretary, Professor A. J. Cook, Agricultural College, Mich., so that they may be announced in the programme.

THE ENTOMOLOGICAL REPORTS OF DR. LE BARON.—Professor S. A. Forbes, Champaign, Ill., writes us as follows: "I have lately received from the family of Dr. Le Baron a supply of duplicates of his four reports as State Entomologist of Illinois, 1871–74, and wish to offer, through the AMERICAN NATURALIST, to send copies, on receipt of postage, to any one who may wish them to complete their series."

EMBRYOLOGY.[1]

RESEARCHES UPON THE DEVELOPMENT OF COMATULA.[2]—The important and complete observations of Barrois on the development of *Comatula* were made upon materials found at Toulon and Villa-Franca, and kept alive in cribs or boxes anchored in the harbor of Villa-Franca. He records a singular periodicity in the breeding habits of this animal. They deposit several crops of ova during a single season (April), and therefore produce several broods of young which become successively attached to the arms of the parent animals. The development of Comatula covers a period of seven days. On the first day oviposition, segmentation, and the formation of the blastula takes place; on the second day the gastrula and blastopore is formed; on the third day the enterocoel, intestine, water-vascular ring, etc., is formed. On the fourth the development of the visceral mass is completed; on the fifth day there occurs the displacement or rotation of the visceral mass, constituting a sort of metamorphosis; on the sixth day the skeleton is formed, and on the seventh hatching occurs.

The following general conclusions are submitted by the author at the close of the memoir — *Fundamental Homologies.* The first and one of the most important results which have been established by the foregoing studies is the proof of the homology between the peduncle of the larva of Comatula and the preoral lobe of other Echinoderms, between the calyx of the larvæ of Comatula and the body, properly so-called, of the larvæ of other Echinoderms. But, aside from this important homology, the development of Comatula differs in two important respects from that of other Echinoderms.

First difference.—In the ordinary Echinoderm-larva (*Asterias, Echinus*), the whole of the body, properly so-called (the entire body, save the preoral lobe and its appendages), is converted directly without any change of place into a young Echinoderm, so that the latter is found to be inserted at one edge of the preoral lobe. In Comatula, on the contrary, we have seen that the body, properly so-called (in other words, the calyx), is pushed towards the extremity of the embryo, so that instead of being, as in other Echinoderms, lodged at one side of the preoral lobe (otherwise the peduncle), it assumes a terminal position. Nevertheless, we also know that if the regular and normal mode of development presents

[1] Edited by Prof. Jno. A. Ryder, Univ. of Penna., Philadelphia.

[2] Recherches sur le développement de la Comatule, I (*C. mediterranea*), par Dr. Jules Barrois, Directeur du laboratoire de Villefranche. Recueil Zoologique Suisse. IV. No. 4, pp. 545–651, pls. XXV–XXX. Genève-Bale. 1888.

this difference, there is an irregular and abnormal mode of development which does not present it at all, and which, under the condition of the primitive relations of the calyx and of the peduncle, presents the same disposition as in all other Echinoderms; that is to say, that in which the calyx is inserted at one side. We are therefore led to conclude that the difference here noted is not a fundamental one, but that it constitutes a simple alteration of the primitive plan common to all other Echinoderms, resulting from fixation and which disappeared immediately after that fixation ceased to occur.

Second difference. — In the ordinary Echinoderm larva (*Asterias, Echinus*), the two peritoneal vesicles maintain their primitive situations, the one at the right and the other at the left, the dorsal face (aboral) of the future Echinoderm being formed at the expense of the portion of the larva which answers to the left peritoneal vesicle. As a result there is a singular discordance between the two faces of the adult and the two faces of the larva, which has been noted by numerous observers, and which consists in this, that the right side of the larva becomes the dorsal face, and the left side of the larva the ventral face of the adult, so that the now outlined Echinoderm is found to be placed in a transverse and a symmetrical position in relation to the preoral lobe of the larva. In Comatula, we have seen, on the contrary, that the ventral and dorsal faces of the larva correspond respectively to the ventral and dorsal faces of the adult in such a manner that the outlined adult (or calyx, in other words), instead of being placed transversely to the peduncle, occupies a symmetrical and regular position in relation to the latter.

We have seen, however, that there is not such a discordance between the positions of the dorsal and ventral aspects of the larva and adult Comatula, and that the two peritoneal sacs here, instead of maintaining their primitive position as in other Echinoderms at the right and left of the embryo, set out on the fifth day, in Comatula, to change their positions, the right sac becoming dorsal, and the left one ventral. Now, if we admit that the formation of the dorsal and ventral faces are subordinated to the position of the peritoneal sacs, we arrive at the conclusion that the displacement of the peritoneal sacs as described above, is a sufficient explanation of the differences noted at the outset.

The paper concludes with further detailed comparisons, which it is difficult to render comprehensible without reference to the original figures. Enough has been noted, however, to show the nature of these newer and more complete results of Barrois, as compared with those of Busch, Thompson, Metschnikoff, Götte and Perrier. The details of development of this most accessible of the crinoids is more fully elaborated in this memoir than in any yet

published, and on that account may be commended to the attention of students.

On the Development of the Commom Sturgeon.—Having been requested by the United States Fish Commissioner, Marshall McDonald, to undertake the investigation of the sturgeon (*Acipenser sturio*), I repaired to Delaware City, Delaware, with that object in view. On the 15th of May mature eggs were found in a large female of that species, which was brought in to Mr. Anderson's float. Fortunately a ripe male was encountered at the same time, also in a living condition, from which sufficient milt was obtained for the purpose of fertilizing the eggs. The eggs were quite free in the abdominal cavity, and they ran out in somewhat the way shot would pour out of a rent in a bag, as soon as the abdomen was cut open. The germinal disk was already formed; in fact investigation disclosed the fact that the germinal disk, or area, is developed before the ovum leaves the follicle in which it is matured. Two sorts of ova were found in different individuals. In some the eggs were brownish gray or olive, in other females the eggs were very much darker and contained far more pigment. In all of them, however, the germinal area was clearly defined at one side often with a distinct round dark spot marking its centre, with a paler ring surrounding the central dark area. External to the pale ring there was a distinct dark ring, followed on its external margin by a narrow pale band, from whence the color over the vegetative pole or yolk became uniform. In the darker variety of eggs some of these rings were not so distinct.

During the first hours of development but slight external changes were observed in the form of the germinal area, but by the second day this area had become distinctly oval; the central dark patch was oval and the marginal pigmented ring also oval. The eggs had also changed shape; instead of remaining globular as they were at first, they assumed a slightly oval shape, the long axis of the oval lying parallel to the long axis of the now elongated germinal area. In the course of the third day the oval germinal area had given place to one of somewhat different configuration. Instead of being oval, the germinal area now became decidedly more elongated and rounded at either end, and constricted at the middle, somewhat like the body of a violin. The medullary groove now became visible, and on the third day was distinctly apparent. On the fourth day the head, body and tail of the embryo had been differentiated so far as to project distinctly above the level of the oval yolk sack, the tail was in fact developing as a free, flat lobe. The heart could be seen pulsating within the thin-walled pericardiac space underlying the head at the anterior end of the yolk sack. Hatching took place on the sixth day after fertilization, at which time the body, head and tail of the embryo were densely pigmented and

dark, while the pigment gradually faded out along the sides of the body where the walls of the latter were continued over the yolk sack, leaving the latter quite light beneath, or of a dirty yellow tint.

The eggs of the common sturgeon are very adhesive and must be transferred to trays formed of wire gauze or thin cotton cloth tacked to wooden frames, as soon after fertilization as possible, and spread out in a single layer. If this is not done the eggs will form large masses through which fresh oxygenated water cannot penetrate, and, as a result, those in the centre of the masses will be asphyxiated, fail to develop and become putrescent. The time occupied in handling them after fertilization should not be over twenty minutes. After two or three hours the eggs are firmly adherent to the wire cloth, thin muslin or cheese cloth, and the trays laden with eggs may be placed in running water without fear of detaching any of them, as their mucigen covering has by this time become quite coagulated and gelatinous, forming a coating over the zona radiata of irregular thickness. The zona proper is quite thin and somewhat elastic, but easily broken, so that the eggs are rather delicate in character. There is no "breathing chamber" developed such as is found in the eggs of many Teleosts. The operator must carefully guard against the appearance of fungus.—*John A. Ryder.*

ARCHÆOLOGY AND ANTHROPOLOGY.

Topinard on the Latest Steps in the Genealogy of Man.[1]—In this highly interesting lecture M. Topinard examines the evidence as to the later stages of human phylogeny, including those embraced in the series of placental Mammalia. He examines the opinions of previous writers on the subject, referring principally to Hæckel, Vogt, Huxley, and Cope. He commences by a discussion of the systematic relations of the contents of the order Quadrumana of modern authors, commencing with the lemurs. He concludes that in spite of certain well-known peculiarities, the Lemuridæ must be included in the same order as the monkeys and man, in opposition to the view of Vogt. He then considers the question as to whether the Anthropoid apes should be arranged with the Old World monkeys or with man, the former being the opinion of Cuvier, Huxley, and Vogt; the latter that of Broca

[1] Les derniéres Etages de la Genealogie de l'Homme. Leçon de Mars, 1888; Ecole d'Anthropologie, Paris. Extract du Revue d'Anthropologie, May 1888.

(unpublished) and of the writer of the present review.[1] He decides in favor of the former.

The probability of the origin of man directly from Anthropoid apes, as asserted by Hæckel (monophyletic) and Vogt (polyphyletic), or from Lemurs direct (the opinion advanced by Cope) is then discussed, and M. Topinard concludes that neither hypothesis can be maintained, in view of the structure of the posterior foot. He does not think that the ambulatory hind-foot of man could have been derived from the prehensile hind-foot of the other quadrumana, and he therefore traces the origin of Homo to a common type in which the prehensile character of that foot has not yet been developed. This is the genus Phenacodus, or some allied form of the Condylarthra. He combats successfully the opinion that the monkeys and man have been derived from Ungulates, in the restricted sense in which that term has been used by some authors who have supported that view. But he adopts the view of Cope, that modern Ungulates and Quadrumana had a common origin, which is closely allied to the genus Phenacodus.

M. Topinard has understood the teaching of the present writer, in quoting him as believing that man was derived directly from Lemuroids without the intervention of the Anthropoid apes. This is to be inferred not only from the observations I have made on the reversion to the tritubercular or lemuroid type to be found in the superior molar teeth of man, but also from the fact that a generalized type of hind-foot is to be looked for in that family. But it was not necessarily the genus Anaptomorphus that possessed all the necessary characters, but rather some other members of the same family. M. Topinard has misunderstood me as believing that Adapidæ were ancestors of the Ungulates. This I have not said. It is perhaps an appropriate place to give a somewhat fuller synopsis of what appears to me to be the state of the evidence on this question. I have already given the outlines of this phylogeny very briefly in the NATURALIST for 1885, and the Origin of Genera (1887) in an article on the "Evolution of the Vertebrata, Progressive and Retrogressive."

In the phylogeny of man from the Protozoon, as given by Hæckel, twenty-one stages were enumerated. Our present information compels us to accept all of these except three, and to insert one prior to the Lemuroids, viz., the Condylarthra. From the Condylarthra of the family Phenacodontidæ to the Quadrumana of the family Adapidæ the transition is very slight, provided that the latter family is not unguiculate, a point not yet settled. It is also likely that the posterior foot in that family is not prehensile. The opposability of the thumb of the posterior foot is, however, not a character of such importance that it need be much considered in

[1] American Naturalist, 1885: "Origin of the Fittest," 1887.

this connection. A very slight modification only of an ambulatory foot would make a prehensile one like that of the Simiidæ, and *vice versa.* In any case, whatever may have been the later stages in the phylogeny of Homo, we can regard such Lemurs as the Adapidæ as in the direct line from the Phenacodontidæ.

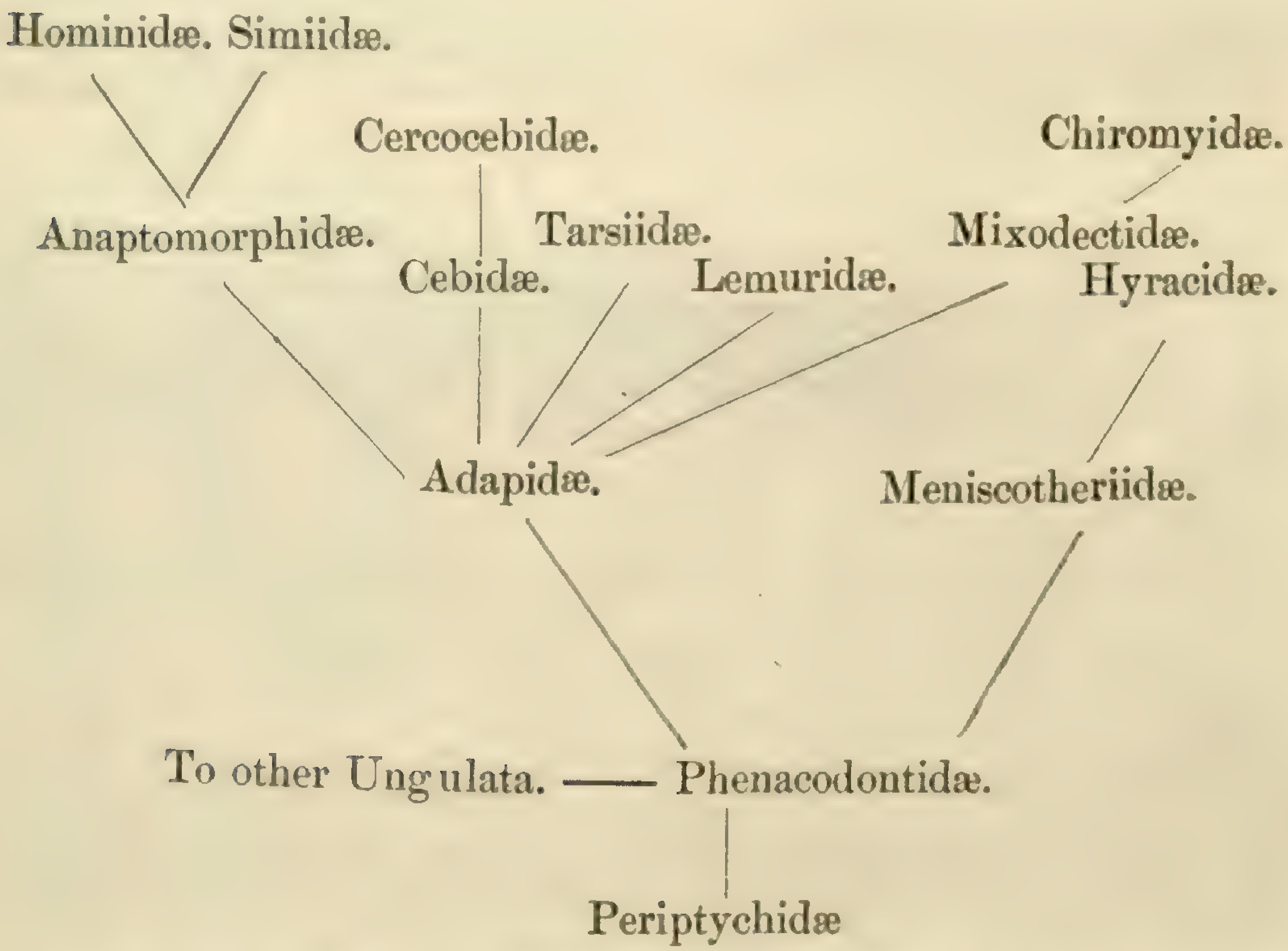
There is a remarkable resemblance between man and the Anthropoid apes in some parts of their skeleton in which they differ from the monkeys (Cercopithecidæ, Cebidæ, Hapalidæ, and Lemuridæ). These characters seem to have been neglected by taxonomic writers. In the first place, the Anthropomorpha (Hominidæ and Simiidæ) agree in wanting anapophyses of the vertebræ, while the families of monkeys and lemurs, above mentioned, agree with the Carnivora in possessing them. This gives a distinctly different character to the vertebral articulations in the two divisions. In the Anthropomorpha the intertrochlear crest of the humerus is present, while in the other group it is wanting. The same division has the bones of the one carpal series alternating with those of the other, while in the true monkeys these bones are generally opposite. In the one group the os centrale is rarely present; in the other it is always present. On these grounds I proposed to adopt the Anthropomorpha as a division (sub-order) of the order Taxeopoda, of equal value with the Hyracoidea, Condylarthra, Daubentonioidea, and Quadrumana. The form of the terminal phalanges in all of these groups show clearly that the Taxeopoda must be referred to the Ungulata in the large sense in which it was used by Lamarck and his contemporaries when the term was first introduced. In the system as I have adopted it, the Ungulata are those placental Mammalia which are not mutilate, unguiculate, or edentate, or those whose terminal phalanges are flattened in adaptation to support only, and not for prehension. In this view the marmosets (Hapalidæ) constitute an anomaly, perhaps not to be included in the order, since they are truly unguiculate. The Hyracidæ, on the other hand, show their close affinity with the Quadrumana, not only in their osteology, but also in the structure of their horny nails, which are (except those of the second digits) those of monkeys. These considerations then give the following system of the Taxeopoda :—

Sub-order I. *Hyracoidea:* family Hyracidæ.
" II. *Condylarthra:* families; Periptychidæ, Phenacodontidæ, Meniscotheriidæ.
" III. *Daubentonioidea:* Chiromydæ; Mixodectidæ.
" IV. *Quadrumana:* Adapidæ; Anaptomorphidæ; Tarsiidæ; Lemuridæ; Cebidæ; Cercocebidæ.
" V. *Anthropomorpha;* Simiidæ; Hominidæ.

In the Daubentonioidea (Gill) the incisors grow from persistent pulps. In the Chiromyidæ the crowns of the molars are simple,

and there are no canines; in the Mixodectidæ the crowns of the lower molars are quinquetubercular, and canines are probably present. In the Quadrumana, Schlosser has shown that in the Lemuridæ the inferior canine teeth are decurved and similar to the incisors, the teeth functioning as such, being the first pre-molars. In the other families of Quadrumana true canines are present in the lower jaw.

From the foregoing considerations the phylogeny of these families will be as follows:—



It may be remarked that the canine teeth in the Adapidæ are of very various development, being incisiform in Adapis, small and conic in Tomitherium, and large in Notharctus. In Anaptomorphidæ the canines and incisors are erect, and not decurved as in Lemuridæ.—*E. D. Cope.*

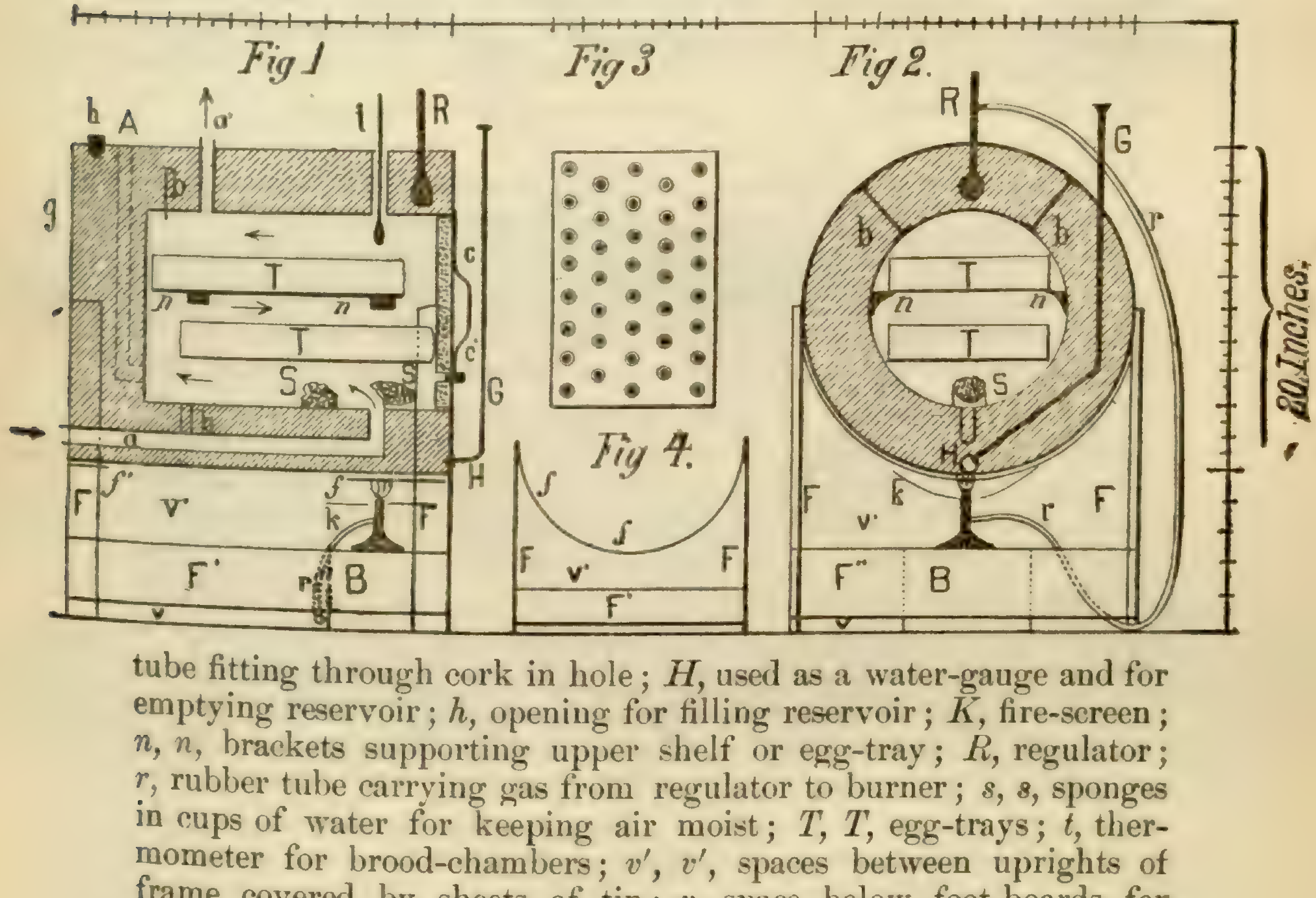
MICROSCOPY.[1]

On Fixing Sections to the Slide.—Schällibaum's collodion fixative is found to be unreliable when used with the more elaborate micro-chemical reactions to which our advanced technique subjects the sections on the slide before mounting. Thus, sections fixed in this manner drop off in absolute alcohol. *Mayer's albumen fixative* is absolutely reliable, and should be used whenever sections are loosely coherent in their parts. One cannot obtain neat results with this, except by means of a very *even* and thin *film*, to secure which proceed as follows: A small drop of fixative is spread on the slide with the ball of the index finger. Excess of fixative is removed by wiping the finger dry and continuing the rubbing until no frothy streaks appear in the film. Then tap the moist surface lightly with the finger, so that by light reflected at a proper angle it appears pebbled or finely stippled. Each section is pressed into the film with a brush, and when the slide is full a piece of filter-paper is placed over all and firmly pressed with the finger until every part of each section is in even contact with the glass. Then heat the slide *over steam* until the paraffin melts, and then plunge into turpentine. The film is opaque in alcohol, but this is corrected in turpentine and mounting. Should the presence of the foreign albumen in the sections be undesirable, we have recourse to *Gaule's* alcoholic fixative. This is no fixative in itself, but simply a means by which the albumen molecules of the section are brought into the same adhesive contact with the glass as those of ordinary fixatives. The slide is brushed over with weak alcohol (40–70 per cent.). The stronger alcohols evaporate too rapidly. The sections placed on this film flatten out beautifully and can be shoved about if alcohol enough be present. When the film has evaporated thin the sections stick with great pertinacity. Superfluous alcohol is removed with filter-paper, and the slide must then be evaporated to *dryness*. The thermostat at 40° C., for 1 to 2 hours, is most useful in securing this result. The paraffin should never be allowed to melt. It is removed by turpentine, as for other fixatives. Celloidin sections stick well with this method.—*J. Nelson, J. H. U., Balto., Md.*

A New Laboratory Incubator and Thermostat.—*Description of Cut:* Fig. 1, plan of longitudinal section; Fig. 2, plan of cross section; Fig. 3, view of egg-pan, from either top or bottom (dark circles are aerating-holes, $\frac{3}{4}$ in. diameter); Fig. 4, end

[1] Edited by C. O. Whitman, Milwaukee.

view of supporting frame, $\frac{1}{24}$ natural size—other figures, $\frac{1}{16}$ natural size. *Explanation of letters: a*, inhalent air-tube, 1 in. diameter; *a'*, exhalent air-tube; *B*, block supporting Bunsen burner; *b, b*, braces holding interior drum against upward pressure of the water; *c*, cover fitting into the end of interior drum or brood-chamber; *c'* (placed near lower end of handle of cover), cork-stopper fitting into a thermometer-hole through the cover; *F*, upright pieces of supporting frame; *F', F''*, side and end base-boards of supporting frame; *f*, fire-plate, portion of *f* the supporting belt; *G*, glass



tube fitting through cork in hole; *H*, used as a water-gauge and for emptying reservoir; *h*, opening for filling reservoir; *K*, fire-screen; *n, n*, brackets supporting upper shelf or egg-tray; *R*, regulator; *r*, rubber tube carrying gas from regulator to burner; *s, s*, sponges in cups of water for keeping air moist; *T, T*, egg-trays; *t*, thermometer for brood-chambers; *v', v'*, spaces between uprights of frame covered by sheets of tin; *v*, space below foot-boards for ingress of air, tubing, etc. The tube *A* is not essential, but may be convenient at times, as seen below.

The structure is essentially a water-jacketed bucket, made by fitting a smaller cylinder or drum 16x19 in. inside a larger drum 20 in. in diameter by 24 in depth, thus leaving the space shaded in the cut for water. The cover has a double wall with air space (dotted in Fig. 1). It slips into its place like the cover of a tin pail. With only the tube *A*, and properly supported in the upright position, the gas-flame burning at *g*, the hole *c'* open, and a regulator at *H*, we have the essentials of a laboratory incubator. The air passing through the tube—surrounded by warm water for a considerable distance—is so warmed as not to chill the eggs placed in the brood-

chamber. This was the form devised several years ago by Professor Birge, of Madison, Wisconsin, and because for laboratory purposes comparatively few eggs are needed, and principally the earlier stages of development, we secure an efficient incubator and thermostat at a trifling cost. (Made of sheet-tin, the cost is not over five dollars.)

By modifying this form I have made a more elaborate, but more convenient, machine, which, having successfully stood the test of three seasons' work at the Johns Hopkins Laboratory, I venture to describe. The "drum" was placed in a horizontal position, the tube *a* was added (making *A* superfluous). Apertures *h* and *R* and tubes *a'* and *t* were also added, as shown in the figures. The "drum" was supported by a frame similar to what we get by taking off the top of a table and turning the rest upside down. The legs or uprights at each end were joined by a strip of sheet-iron 2 in. wide, forming a saddle-like belt. The forward end-strip, being cut six inches wide at its middle point, makes a fire-plate for the flame to play on. The point *s* tends to be the coolest; hence the position of the burner. The thermometer *t* should mark the upper limit of the incubation temperature. A sheet of tin is hung by wires, so that the Bunsen burner projects through a hole punched in it, and thus prevents reflection and loss of heat into the surrounding space. The whole structure should rest on a plate of zinc if the floor or table on which it stands is of wood. A coat of paint on the drum reduces radiation and consequent gas-consumption. The eggs are placed in pans 2 inches deep by 10 by 16. Each pan is made of two similar halves that slip one over the other, like the lid of a cardboard box. Thus either side may be up or down, and therefore all the eggs in the pan (forty or more) are turned at once by turning the pan, and, besides, the marks on the eggs are easily inspected. For ordinary thermostat purposes, the trays can be replaced by shelves or drawers. The air circulates in part as indicated by the arrows, with such an arrangement of the pans as shown in the cut, but most of the air passes through the trays directly, and, thus, between the eggs.

If a space be left above the water and the hole *h* be made to connect with an aspirator, on the one hand, and the tube *A* on the other, warm, moist air can be forced into the egg-chamber; but the sponges *s*, *s*, are practically sufficient. I found by experience that even though the cylindrical shape is the one giving greatest strength (as well as ease of construction), that zinc is not a good material for this machine to be made from, as it softens under warmth and yields gradually to the pressure. Therefore, if tin be departed from, copper should be chosen; but, of course, this will raise the price.—*J. Nelson.*

SCIENTIFIC NEWS.

—Dr. Roland Duer Irving, Professor of Geology and Mineralogy at the University of Wisconsin, died at Madison on the 30th of May last. Professor Irving was in comparatively good health on the preceding Saturday, having taken a boat ride with his family on one of the lakes surrounding Madison. On Sunday morning about eight o'clock he was stricken with paralysis. During the day he was conscious, but could not be made to realize his serious condition. On Monday he was only half conscious, and from that time gradually passed into a deep stupor, which faded into death on Wednesday morning. Dr. Irving was the chief in charge of the Lake Superior Division of the United States Geological Survey. His most important work was the establishment of a great break in the geological continuity between the Laurentian and the Huronian systems, and (together with President Chamberlin) the erection of a new system, the Keweenawan, between the Huronian and the Cambrian. At the time of his death he was engaged with Professor C. R. Van Hise in the preparation of a monograph on the iron-bearing rocks of the Penokee-Gogebic region. Professor Irving was a native of Staten Island, New York, and was a nephew of Washington Irving. He leaves a wife and three children.

—Henry Carvill Lewis, Professor of Geology at Haverford College and of Mineralogy at the Academy of Natural Sciences, died Saturday at Manchester, England, of typhoid fever. He was in England with his wife and child and intended remaining abroad four or five years. Most of this time was to be spent in Norway studying the geology of that country. He was also to read a paper before the British Association for the Advancement of Science. Prof. Lewis was son of J. Mortimer Lewis and was born in Germantown, Pennsylvania, November 16, 1853. He graduated at the University of Penna., in 1873, and in 1879 served in the State Geological Survey. He was elected Professor of Mineralogy by the Academy of Natural Sciences in 1883 and to the Chair of Geology in Haverford College in 1883. He went to Europe in 1885 and engaged in studying microscopic petrology in the University of Heidelberg. He had charge of the mineralogical department of the American Naturalist for a time. Professor Lewis was an enthusiastic student, and a man of most amiable character. His loss is a serious one to the scientific interest of his native city.

—The Boston Biological Laboratory was incorporated in 1888, and is under immediate charge of Director C. O. Whitman, Ph.D., and Instructor B. H. Van Vleck, S.B. It is at Wood's Holl, Massachussetts. A convenient site has been secured close to the shore and to the laboratories of the United States Fish Commission. The Laboratory building consists of two stories: the lower story for the use of students receiving instruction, the upper story exclusively for investigators. The Laboratory has boats, dredges, and other collecting apparatus; it is also supplied with running sea-water, with alcohol, and other reagents, glass-ware, microtomes, aquaria, etc.; a limited number of microscopes for students' use and a small reference library. The Laboratory for Students was opened on Tuesday, July 17th, at 9 A.M., for a systematic course of six weeks in zoology. By permission of the Director students may continue their work until September 20th, without additional payment. Microscopes, glass-ware, etc., are supplied without extra charge except for breakage. The fee for this course is twenty-five dollars ($25), payable in advance. The Laboratory for Investigators is equipped as fully as the means permit. Microscopes are provided, but it is believed that investigators will find most of their indispensable wants satisfied. The fee for an investigator's table is fifty dollars ($50) for the present season. Owing to the late day on which the announcements were sent out there are but about half a dozen students present this year in either department.

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OUR FRESH-WATER ALGÆ.[1]

BY EDWARD S. BURGESS.

WHAT do you mean by the Fresh-water Algæ? and what interest do you find in them? are the questions I find asked me. Go with me to the coast, if you would learn my answer. Notice the sea-weed growing along the shore; see the dark olives and browns shown in the rockweed, left dripping and slippery by the retiring tide; note the waving tufts of green laver and sheets of membrane-like sea-lettuce floating near the tide-mark, and watch the beautiful red mossy cushions of delicate growth washed in by the breaking wave. Ask of almost any dweller on the coast and he will say, "People nowadays call them algæ." The longer you watch them the more attracted by their beauty you will become; soon you will begin to collect and mount them like other visitors to the shore. At first the most beautiful only will be collected; then others that are less so, "simply for the variety," as you may apologize to yourself; finally you will end by determining to keep a specimen of every kind, whether beautiful or not. And now you approach the stand-point of science, for science sees interest in every representative of a race, whether that race be high or low; and finds in every plant a right to our regard in the fact of its inheritance of the mystery of life.

But every summer must have its end, and so there will come the time of packing up the glowing specimens with their endless shades

[1] Condensed from a lecture delivered at the United States National Museum, Washington, D. C., January 7, 1888.

of reds and greens and olives. With the return to the interior the desire rises to expression, "Would that the inland waters contained such treasures as these mosses of the sea!" It is the old story, the wish is father to the thought, and the thought will perchance come to you, that perhaps they do; why should there not be mosses in the lake and river, brook and clear spring, as well as in the brine? and you resolve to look for yourself on your return, or you ask some one who knows to tell you if there are not also algæ in the inland waters. "Yes, certainly," he replies, and you then inquire, "Why is it then that I have never seen them?" to be reminded in turn that it is not the first time the eye has been awakened to perception of the beauties round its home by travels in a foreign land. Besides, the algæ of fresh-water are smaller and less conspicuous than those of the sea; many are microscopic, and many others are, when taken singly, but just visible to the naked eye. They are less varied in color as well, and so it has happened that many collectors know the sea mosses first, and if knowledge of the algæ of fresh water comes at all, it comes as a derivative from the other.

To compare the actual organs of the alga and the flowering plant, we remember that the flowering plant is adapted to land-conditions, securing nourishment from the air by its leaves and from the soil by its roots. The alga is adapted instead to water conditions and has no leaves nor roots for procuring nourishment, but absorbs through its general surface. The alga may or may not have root-like bodies (rhizoids), or a root-like base (a disc or hold-fast), but if present, these are simply to fix the plant in position. Presence of distinct stem and branches is optional with either. Most flowering-plants produce leaves; most alga do not; those leaf-like bodies which are produced, as by the Sargassum or Gulf-weed, are called phylloids; these do not occur in the strictly fresh-water species. As its name indicates, the flowering-plant is to produce flowers, and from them seeds containing an embryo of one or more seed-leaves (cotyledons). Alga produce no flowers and seeds, but instead, as a usual rule, spores. Their spores resemble seeds in appearance and in function, but contain no embryo and differ in details of development. The alga is thus the less specialized, the more simple, the lower in the scale of creation. Instead of delegating the functions of plant-life to separate portions of itself as

organs, the alga often combines them all in a single cell or ultimate constituent. In cases where the alga is composed of many cells the same principle often holds good, each cell being sufficient unto itself, uniting within its own small limits all the multifarious employments or functions which make up the life-activity of its species, and therefore able to live equally well if by accident it becomes detached from its associated cells. Hard-working cells are these, for they have not yet learned the rudiments of the division of labor; cells of manifold activities certainly, and correspondingly hardy, self-dependent, and ever unsubdued. They live and replenish the earth unseen by man, till by effects or masses of individuals they move him to wonder, and, as in the middle ages, to ascribe their sudden-seeming presence to the wrath of heaven or the agencies of the black art or to the medium of alchemy.

The present needs will not permit my entering into the subject of the scientific classification of the algæ, but it may be of service to notice some of the principal groups for which common names are in use. According to habitat we may divide all algæ into the marine and fresh-water divisions, including with the latter the ærial species, surface-dwellers on moist earth, sand, rocks and trees. Recombining all the algæ, they may be again divided according to coloring matter, contained, generally as a liquid, in their cells, classing them therefore as the red, olive and green algæ, and fourthly as the Phycochroms, the last having as their characteristic a bluish cast seen in the green, ashen or grayish hue which pervades them. The red algæ, so prized by collectors on the shore, are scantily represented in our inland waters; the olive do not appear at all; but the two other divisions find in fresh-water their chief representation. The green algæ of the tide-marshes along the coast are very conspicuous, and of uncounted numbers, but of very few species comparatively; those of fresh-water are probably still more abundant in individuals, certainly in species. The Phycochroms never reach as great a size as do members of each of the other sections; they are, indeed, chiefly microscopic, as individuals, if not as masses or colonies. Their cell-contents are also less highly organized. Their chief abode is in slowly running streams and quiet waters. They are the Cyanophyceæ of Goebel and of various authors since Nägeli, in 1849. They are remarkable for the pres-

ence of a beautiful blue coloring matter, phycocyan ; and for the fact that no sexual modes of propagation have been discovered in them; nor, at least with rare exceptions, is there any evident nucleus, or central denser protoplasmic body, in their cells, such as is the rule elsewhere among plants.

Multiplication in the algæ takes place in either of several ways; the most common is that of fission, as in the multiplication of cells in a flowering-plant, where each cell divides into two parts, each a perfect whole like its parent. The two parts gradually increase in size until they reach their full degree, then themselves divide again, and so on. They may or may not remain attached to each other. Another mode of algal multiplication is by budding (gemmation), where the bud-like protrusion which grows into a new cell remains usually attached to its parent. A modification of this, prolification, consists of numbers of new cells arising from the side or end of the old, as if intended to become a separate individual, but often long adhering to the other, as if an attached child unwilling to remove from its parent. Some algæ, as the Caulerpa, rely on this method for their chief mode of propagation, as do so many of the higher plants upon "spreading by the root" in place of production of seed.

Another curious modification of budding is common in the red algæ, the production of tetraspores, bodies which are formed by division of a cell into four equal parts, each of which becomes a spore, able to grow into a new plant, and thus analogous to the bulblets produced by tiger-lilies and some onions.

Other algæ are reproduced by sexual methods, producing spores in some part of the process. Among the most remarkable of these are the zoospores, small seed-like bodies, usually soft and oval, sometimes spherical, tipped with one, two or more waving threads (cilia), which lash the water and carry the spore onward in the current thus produced, sometimes with great velocity and sometimes for several hours. The cilia finally fall off and the zoospore comes to rest; and if favorable conditions have befallen it, it has effected a lodgement on some resisting substance, there to begin to lengthen, divide into cells, and grow into a new plant. During their motile stage these little spores seem like so many little green animalcules darting about; so indeed they were long thought to be; and their names still perpetuates this idea, the word zoospore meaning "animal-spore."

Another kind of spore, motionless, unlike the preceding, the zygospore or "yokespore," is produced only as the result of two cells uniting and fusing their contents, the confined mass becoming the zygospore. This process of coalescence, known technically as conjugation, occurs in the beautiful Desmids, algæ so distinct as to form a group by themselves and therefore not now to be entered upon. The process also occurs in the Spirogyras and their relatives common in conspicuous green masses in still waters, each mass composed of long threads tangled together which shine with silky lustre when taken out of the water giving them their English name of silkweeds. These spores are smooth or spiny, often studded with knobs or branching thorns; they have a thick, hard case, resisting the drouth of summer and the cold of winter, enabling them to await their proper time of growth in safety. The zoospores are liable to confusion with certain green infusoria among animalcules, the zygospores with certain similar unicellular algæ as species of Acanthococcus, now thought to have been often mistaken in this country for desmid zygospores.

A very curious kind of reproduction is that of the Vaucheria and its allies, the production of "oospores," which resemble zygospores in their resting-period and in their hard, shell-like case, but differ in formation. And if with Goebel we include the Charas among the algæ, we are presented by them with still another mode of reproduction, the formation of "nucules" or nutlets, dark or red, often strikingly handsome to the naked eye when abundant in their little clusters on the green feathery plant, each nucule surrounded by its little involucre and itself chased as if by chisel with a spiral line winding many times round it.

But perhaps the most complicated of algal systems of reproduction is that of the red algæ, to be observed in fresh water in the Batrachosperms, Lemaneas, etc. It may be called the cystocarpic system, its result being the formation of a fruit or cystocarp, filled with spores, often reminding one of the grains in a pomegranate or the seeds in a water-melon, and sometimes still more regular in arrangement. Remembering the sexual system as developed in flowering-plants requires, previous to the formation of seed, the presence of the stamen and the pistil, respectively the male and female elements; we look for their counterpart in these plants, and

find it in the presence respectively of antheridia and archegonia. In the violet batrachosperms of fresh water these organs are produced on separate individuals. The antheridia contain small motile bodies, antherozoids, analogous to the pollen contained in the anthers of flowering-plants, and to the spermatozoids of animal life. These antherozoids find their way upon the other plant to where a long hair-like tube (the trichogyne) opens, through which their fertilizing influence reaches the protoplasm mass in the bulbous base of the tube (the archegonium or carpogonium). The protoplasm on fertilization swells, divides, usually forms new cells around it, as if walling itself in, and then a series of new cells within, many of which become spores, the whole fruit so formed becoming as full of spores as a stramonium pod of seeds, and generally resembling the latter in their position as well.

There is great variety of form among the algæ of fresh water, even among the unicellular species. It might be thought that these species, where the whole plant is composed of but a single cell, would present little variety; especially when it is considered that such simple cells commonly float loosely in the water, and in situations enabling the supposed normal spheroidal cell-form to develop itself, free from the influences of crowding or lateral stimuli. But not so simple is the plan of nature, and a great range of shape exists among the single-celled algæ, from the spherical of the common protococcus of our trees and walls to the bur-like spiny Polyedrium. For instance, one Rhaphidium is crescent-shaped, another needle-shaped, another unicellular algæ is shaped somewhat like the letter S, another like a J, another a C. The Botrydium is balloon-shaped, the Chytridium often urn-shaped, others appear as little discs, others ellipses, others cubical or pentagonal. When associated in masses, pressure and the exigencies of growth change the shape of those naturally circular into irregular polygons. Some species of Ophiocytium grow into curious coils; some Polyedriums are exact triangles, others take the form of a Greek cross. Extend our view to the desmids and diatoms, which are also of the unicellular algæ of fresh-water, and the number of cut and fantastic forms which a plant of a single cell may present, becomes indefinitely increased.

The larger number of species of the fresh-water algæ are, however, of more than one cell. Of these multicellular algæ some grow

into discs, as Coleochæte, some expand into a leaf-like membrane, as Prasiola, or widen from hollow spheres and tubes into broad undulating sheets like the Tetrasporas, others grow in solid globular masses, as the Chætophoras, one species of which occurs in the form of little green balls like peas, and hangs on dry grasses and other supports in quiet pools in spring. Others of looser texture, expand into an indefinite and irregular mass which will crumble at a touch, or form a gelatinous stratum which slips like oil through fingers that endeavor in vain to raise it from the water. Many others become firmly adherent crests on rocks, especially under falling water. Most of the more beautiful species become filaments, usually formed of cells placed end to end, sometimes composed of several or many such filaments bound together, either branching or not, and attaining particularly fine development in the Batrachosperms, where the many branched and forking filaments are clad with radiating whorls of smaller branches, often in the most perfect regularity.

Very commonly gelatinous in substance, many of the larger species are too frail to bear lifting out of the water, and yet endure considerable stress of their native current without harm, swaying with graceful motion as becomes beings born to the water. As there are all degrees of consistency in jellies, so there are in algæ, from the tough jelly of a Prasiola, to the fluid jelly of a Tetraspora. Professor Wood named his genus Pagerogala, "frozen milk," from its seeming to float like white curds of clotted milk in a Pennsylvania spring. Some Draparnaldias may fairly be called succulent, others approach nearest of any of our algæ to the wiry character; the Lemanea is sometimes almost leathery; Spirogyras feel under the fingers like a lock of hair; some of the largest Confervæ are tough enough to support considerable weight, and have such strength of fibre that German ingenuity has tested their capability for textile use, and not only made mattress-stuffing and paper from them, but actually fabricated them into coarse trowsers, as if to show that the common phrase "clad in weeds" is not incapable of the most literal of fulfilments. Stranger still than any Confervæ, are the mailed knights among the algæ, the little diatoms, absolutely unyielding and encased in silex, like so many little glass boxes under the microscope all curiously chased and set with flashing points and knobs. Some of

the Charas secrete instead of silica, a sheath of carbonate of lime about themselves, until the whole plant seems a succession of joints of stone, or links of white lime, giving it its popular cognomen of stonewort.

The colors of our fresh-water algæ are varied to a degree that may surprise the student who expects only green. There is considerable variety even in their green, from the usual grass-green of the Spirogyras to the pea-green of some Palmellas; the little "water-flower," so to render its name, *Anabæna flos-aquæ*, is a verdigris-green; *Chlamydomonas hyalina* is called by Wolle a milky-green. Many shades of red are found, vermilion in Chlamydococcus, scarlet in Thorea, blood-red in *Glœocapsa sanguinea*, amethystine in *Leptothrix tinctoria;* Hildenbrandtia is often purple, one of the Chantransias is rose-purple, a Lemanea is violet; species of *Chroölepus* range through ash, yellow and orange to golden-red; Tuomeya is said to be olive-colored, Hydrurus ochre; some Vaucherias are brown, one Glœocapsa is black; a Leptothrix is straw-colored, another fawn, a Chantransia steel-blue, a Cylindrocapsa pearly. Many preserve their color when dried; others change, some simply by fading to a lighter shade of their previous color, others to a new tint; one Batrachosperm is described as at first of a mouse-gray color, then yellow, and on drying, violet; *Chantransia macrospora* and Thorea are, when living, dark green, but dry a beautiful purple-violet; the Sweet Chroolepus is tawny when fresh, changes to an ashen-gray and finally greenish; a kindred species is reddish-orange when olive, light yellow on drying; *Zygnema purpureum* changes from yellowish-green to dark purple; *Lyngbya tinctoria,* says Wolle, from purple to violet steel; *Vaucheria dichotoma* may stand as type of the change so frequent in the higher plants, from green to brown. Many algæ unite several colors at the same time; almost all do so when we compare the spores with the vegetative growth; a remarkable instance of variegation in vegetable growth alone is seen in a new Lyngbya found by Wolle in the Lehigh at Bethlehem, Pennsylvania, waving in tufts six inches long, "the extremities bright-blue green, lower parts changing to yellow-brown; and at last fading out to a colorless base."

Few of the odors possessed by the algæ have received a name. Out of the 1300 species recorded in this country by the Rev.

Francis Wolle, there is perhaps but one which has an odor remarkably offensive; this, the Hydrurus is, however, so unpleasant that the Dane Lyngbye remarked of it seventy years ago that "it could be endured only by an algologist." Bory called attention early in this century to "the most peculiar odor" of Lemanea when burned. Extend the view to the Charas, and to the diatom Schizonema, and a number of species of imitating or unpleasant odors are met; but the number of algæ which are in themselves possessed of much odor of any kind is few. If any persons associate disagreeable odors with the algæ, it is doubtless from confusing the odor of a place with that of an alga happening to be at the time its resident. Nor are the algæ without examples of exquisite fragrance; man might not have thought to look here for the sweetest odor, but Nature has not forgotten to add that charm to some of these, her lowly children; one of them *Chroölepus odoratus,* has been known in Denmark for over seventy years as the "sweet conferva"; it grows also on the bark of shade trees along highways in Pennsylvania. Perhaps more interesting still is the fragrance of the violet-moss, *Chroölepus iolithus,* which attracted the attention of Linnæus almost a century and a half ago; it grows as a thin glaucous, green or reddish-orange layer over stones in the Alps and in our own country in the White Mountains, causing them to "give forth a strong odor of violets." The Swiss are said to carry these stones home and by occasional moistening, to renew the odor from time to time. These Alpine people call it "Veilchen-moos" and the "Veilchen-stein"; and this latter was adopted as its name in science by Linnæus, for the specific name he gave it and which it still bears, is to be translated *Violet-stone.*

The size of our fresh-water algæ has been already referred to as commonly microscopic; yet there are many of considerable dimensions. About Washington we have Tetrasporas growing a foot long, beautiful undulating sheets of translucent green floating out on flowing water; some of our Cladophoras are still longer; and the sac-like Water-nets and the string-like Confervæ equal or exceed them. Any locality may yield however, for one specimen of six inches, a score of but one inch, and for each of the latter, an equally increased proportion on or below the border-line of vision.

Many minute algæ become very conspicuous by reason of their

immense numbers however; sometimes the whole surface of a lake is covered with them. For several years a little pond near Washington attracted my notice by its uniform dingy green; examination by the microscope proved regularly that it was due to presence of myriads of a very minute alga, a Staurastrum, a pretty little desmid with six radiating points of green. The Bavarian lake, the Schliersee, grew turbid under the ice of the winter before the present, acquiring a general green or blue, due, suggests Dr. Harz, to enormous quantities of the microscopic alga *Palmella uvæformis:* then the color changed under the ice to a yellow-red and at last to peach-color from the incoming of another alga, *Clathrocystis roseo-persicina*, which is said to have attacked and destroyed the other. This fittest survivor, conqueror in the battle of the algal hosts under the ice, was found lurking in wide expanses of beautiful peach color on the mud bottom of Babcock Lake here in Washington, recently drained to assure the safety of the Washington monument. The green surfaces of stagnant pools everywhere familiar, are also examples of minute algæ occurring in vast masses.

The larger species may be mounted on cards or sheets of unglazed paper as is so common with the marine algæ; or on sheets of mica for coarser microscopic examination; or preserved for the same purpose in bottles of carbolized water. My practice is, however, to preserve specimens for the microscope, large or small, in cement cells, using as a medium King's fresh-water algæ fluid; specimens of three or four years' standing still remain unchanged. Some species may be collected throughout the year, even under the ice; in the city of Washington many are constantly abundant as green coatings on trees, walls and stone steps; others live in the drinking fountains, species, as *Draparnaldia plumosa*, which exist only in pure water; others are to be sought on the damp wood work of pumps; still others in the conservatories, on damp bricks and flower-pots and in the soil. The mud of the Potomac margin contains its own species, and there the Vaucheria waves in profusion; Oscillarias, Palmellas, and other unicellular species abound; and outside of the city, springs, streams and pools are each full of their treasures, wet banks and even meadows yield their own peculiar species; and the early spring pools filled by Potomac overflows are especially the haunt of the Algæ.

And now if interest has been awakened in these minutest of the pet nurslings of nature, the next step is to collect, examine and preserve them. Do not stop at that point let me beg of you, for it is but the threshold; but seek to discover the entire life-history of the species around you. Uncounted problems of supremest interest await the verdict of those researches. Only by such work can the foundation of a true and permanent classification of the algæ be laid. Questions of far-reading importance follow regarding their relations to the fungi, and to animal life, and their ultimate part in the scale of nature. Uses the algæ may have, many and as yet unknown; but perhaps none more important will ever be discovered than their service which science already knows, that of furnishing a means by which to learn of the origin and the processes of life. The algæ as among the simplest of living things stand close to the gateway whence life first entered into the world, and invite the hope that their investigation may yield many important additions to the world's knowledge of what life is.

REVIEW OF THE PROGRESS OF NORTH AMERICAN PALÆONTOLOGY FOR THE YEAR 1887.

BY JOHN BELKNAP MARCOU.

I REGRET that, owing to the delay in the publication of the Smithsonian report for 1886, my record of North American palæontology for that year has not yet appeared, and the date of its publication is still uncertain. For this reason I again publish in the AMERICAN NATURALIST a brief review of the titles of the new works on North American palæontology, which I have collected during the year 1887, in order to give the workers in this branch of science a brief view of the work of the past year, leaving all abstracts, notes and comments to another paper, which will be published either by the Smithsonian Institution or the U. S. Geological Survey.

Truman H. Aldrich, in Jour. Cincinnati Soc. Nat. Hist., Vol.

X., No. 2, pp. 78–83, has "Notes on Tertiary Fossils, with Descriptions of New Species."

Henri M. Ami has an article "On the Occurrence of Scolithus in Rocks of the Chazy Formation about Ottawa, Ontario" in Canad. Rec. Sci., Vol. II., p. 304; on p. 429 he has one on "The Mica Formation in Canada"; in the Ottawa Naturalist, Vol. I., No. 9, p. 121, he has another, entitled "Notes on and the Precise Geological Horizon of *Siphonotreta scotia*"; with T. E. W. Sowter on p. 93, he publishes "Report on the Geological Branch."

L. W. Bailey, in Trans. Roy. Soc. Canada for 1886, Section IV., p. 35, has an article "On the Silurian System of Northern Maine, New Brunswick and Quebec."

G. Baur publishes in AMER. NATURALIST, Vol. XXI., p. 837, an article "On the Morphology and Origin of the Ichthyopterygia."

Chas. S. Beachler has an article on "Crinoid Beds at Crawfordsville, Indiana," in AMER. NATURALIST, Vol. XXI., p. 1106.

Chas. E. Beecher, in Thirty-ninth Ann. Rep. Trustees N. Y. Sta. Mus. Nat. Hist. for 1885, p. 161, has an article entitled "A Spiral Bivalve from the Waverly Group of Pennsylvania."

Walter R. Billings has "A New Genus and Three New Species of Crinoids from the Trenton Formation, with Notes on a large specimen of *Dendrocrinus proboscidiatus*" in the Ottawa Naturalist, Vol. I., No. 4, pp. 49–54.

J. P. Bishop, in Nature, Vol. XXXV., p. 237, has an article "On Certain Fossiliferous Limestones of Columbia County, New York, and their Relation to the Hudson River Shales and the Taconic System."

G. S. Boulger has an article "On the Connection in Time of Changes in Fossil Floras with those of Faunas" in Proc. Geol. Ass., Vol. IX., No. 7, p. 482.

C——— has "A Noteworthy Specimen of Devonian Lepidodendron" in Science, Vol. IX., No. 225, p. 516.

J. H. Chapin has "An Interesting Find" in Proc. and Trans. Merid. Sci. Assoc., Vol. II., p. 29.

Chapman, E. J., in Canad. Rec. Sci., Vol. II., p. 431, has an article "On the Classification of Trilobites."

J. M. Clarke publishes "Annelid Teeth from the Lower Portion

of the Hamilton Group and from the Naples Shales of Ontario County, N. Y.," and [Communication concerning Mastodon Bones found at Utica, Wyoming County, N. Y.], in Sixth Ann. Rep. N. Y. State Geologist for the year 1886, p. 30 and p. 34.

H. W. Conn has a review of "Cope's Origin of the Fittest" in AMER. NATURALIST, Vol. XXI., p. 465.

J. G. Cooper publishes "Corrections of Article 'On Fossil and Sub-Fossil Land Shells in the United States,' in Bull. No. 4," in Bull. California Acad. Sci., Vol. II., No. 7, p. 376, and "West Coast Pulmonata; Fossil and Living," in Bull. California Acad. Sci., Vol. II., No. 7, p. 355, and No. 8, p. 497.

E. D. Cope has in AMER. NATURALIST, Vol. XXI., p. 468, "American Triassic Rhyncocephalia; on page 1019 of the same journal he has "A Sabre-tooth Tiger from the Loup Ford Beds"; on page 171 of the same journal he has "Formations of the Belly River of Canada"; on page 924 of the same journal he has "Scott and Osborn on White River Mammalia"; on page 469 of the same journal he has "Some New Tæniodonta of the Puerco"; on page 367 of the same journal he has "The Dinosaurian Genus Cœlurus"; on page 566 of the same journal he has "The Marsupial Genus Chirox"; on page 445 of the same journal he has "The Mesozoic and Cænozoic Realms of the Interior of North America"; on pp. 985 and 1060 of the same journal he has "The Perissodactyla"; on page 573 of the same journal he has "The Sea-Saurians of the Fox Hills Cretaceous"; in Geol. Mag., New Ser., Sec. III., Vol. IV., p. 572, he has "Lydekker, Boulanger and Dollo on Fossil Tortoises"; in Proc. Amer. Phil. Soc., Vol. XXIII., p. 234, he has an article "On the Structure of the Brain and Auditory Apparatus of a Theromorphous Reptile of the Permian Epoch"; in the same journal, p. 357, he has "On Two New Species of Three-toed Horses from the Upper Miocene, with Notes on the Fauna of the Ticholeptus Beds"; on p. 146 of the same journal he has "Report on the Coal Deposits near Zacualtipan, in the State of Hidalgo, Mexico."

T. Nelson Dale has an article "On 'New England Upper Silurian'" in Proc. Canad. Inst., Third Ser., Vol. IV., Fasc. No. 1, p. 69.

William H. Dall, in Amer. Jour. Sci., Third Ser., Vol. XXIV., publishes "Notes on the Geology of Florida."

C. H. S. Davis has "The *Catopterus gracilis*" in the Proc. and Trans. Merid. Sci. Assoc., Vol. II., p. 19.

Dawson, George M., in Geol. and Nat. Hist. Survey of Canada, p. 1, has "Notes to accompany a Geological Map of the Dominion of Canada, East of the Rocky Mountains."

Dawson, Sir J. Wm., has an article "On Canadian Examples of Supposed Fossil Algæ" in Rep. British A. A. A. S., 1886, Birmingham Meeting, p. 651; in Canad. Rec. Sci., Vol. II., p. 404, he has an article "On the Correlation of the Geological Structure of the Maritime Provinces of Canada"; in same, p. 499, he has "Notes on Fossil Woods from the Western Territories of Canada"; he has, in Nature, Vol. XXXVI., p. 574, an article "On New Facts relating to Eozoon Canadense"; in Trans. Roy. Soc. Canada for 1886, Section IV., p. 1, he has "Presidential Address: Some Points in which American Geologic Science is indebted to Canada"; in same, p. 19, he has an article "On the Fossil Plants of the Laramie Formation of Canada."

Drummond, A. T., in Canad. Rec. Sci., Vol. II., p. 412, has an article on "The Distribution and Physical and Post-Geological Relations of British North American Plants."

P. Martin Duncan has an article "On a New Genus of Madreporaria—Glyphastræa, with Remarks on the Glyphastræa Forbesi, Edw. and H., sp. from the Tertiaries of Maryland, U. S.," in Geol. Mag., New Ser., Dec. III., Vol. IV., p. 43; in Quart. Jour. Geol. Soc., Vol. XLIII., p. 24, he has an article "On a New Genus of Madreporaria (Glyphastræa), with Remarks on the Morphology of Glyphastræa Forbesi, Ed. and H., from the Tertiaries of Maryland, U. S."; in Am. and Mag. Nat. Hist., Ser. 5, Vol. XIX., p. 260, he has "A Reply to Dr. J. G. Hinde's Communication 'On the Genus Hindia Dunc., and the Name of its Typical Species.'"

William B. Dwight publishes "Primordial Rocks of the Wappinger Valley Limestones" in Vassar Bros. Inst. Trans., Vol. IV., p. 130; in same, p. 206, he has "Primordial Rocks of the Wappinger Valley Limestones and Associate Strata"; in AMER. NATURALIST, Vol. XXI., p. 270, he has "Palæontological Observations on the Taconic Limestones of Canaan, Columbia County, N. Y."; and in Amer. Jour. Sci., Third Ser., Vol. XXXIV., p. 27, he has "Recent Explorations in the Wappinger Valley Limestone of Dutchess County, N. Y."

R. Etheridge and P. H. Carpenter publish "A Catalogue of the Blastoidea in the Geological Department of the British Museum of Natural History" in AMER. NATURALIST, Vol. XXXI., p. 68.

A. F. Foerste publishes in Bull. Sci. Laboratories Denison University, p. 71, "Coal-Measure Bryozoa from Flint Ridge"; in same, p. 89, he has "The Clinton Group of Ohio," Part II.; in same, p. 149, he has "The Clinton Group of Ohio," Part III.; and in Science, Vol. X., No. 248, p. 225, he has "Recent Methods in the Study of Bryozoa."

A. H. Foord, in Geol. Mag., New Ser., Dec. III., Vol. IV., p. 541, has an article "On the Genus Piloceras Salter, as Elucidated by Examples lately discovered in North America and in Scotland."

Persifor Frazer has "General Notes—Sketch of the Geology of York County, Pennsylvania," in Proc. Amer. Philos. Soc., Vol. XXIII., p. 391.

J. S. Gardner, in Geol. Mag., New Ser., Dec. III., Vol. IV., p. 158, has "The Appearance and Development of Dicotyledons in Time"; in Proc. Geol. Ass., Vol. IX., No. 6, p. 433, he has "Fossil Grasses."

Herbert Goss has an article "On Some Recently Discovered Insecta from Carboniferous and Silurian Rocks" in Proc. Geol. Ass., Vol. IX., No. 3, p. 131.

L. P. Gratacap, in Proc. Nat. Sci. Ass. of Staten Island, Extra No. 6, March, 1887, has "Preliminary List of Palæozoic Fossils found in the Drift of Staten Island"; in Amer. Jour. Sci., Third Ser., Vol. XXXIII., p. 374, he has "The Eozoonal Rock of Manhattan Island."

James Hall publishes "Appendix A. Catalogue of Translucent Sections of Rocks and Fossils" in Thirty-seventh Ann. Rep. N. Y. State Mus. Nat. Hist."; in Sixth Ann. Rep. State Geologist for the Year 1886, p. 41, he has "Descriptions of Fenestellidæ of the Hamilton Group of New York"; publishes Fifth Annual Report of the State Geologist for the Year 1885; accompanied by a Geological Map of the State. Transmitted to the Legislature February 16, 1886. Albany: Weed, Parsons and Company, Printers, 1886, pp. 1–47, Plates XXVIII.; James Hall and George B. Simpson publish Geological Survey of the State of New York. Palæontology: Vol. VI. Corals and Bryozoa. Text and Plates. Con-

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THE DIKES OF THE HUDSON RIVER HIGHLANDS.

BY J. F. KEMP.

THE cuts of the West Shore Railway, on the Hudson river, above Haverstraw, and below Cornwall, have done much service to geology in bringing to light the subsurface and unaltered structure of the Archæan rocks. The Stony Point cut did more than any other exposure to convince Professor J. D. Dana of the intrusive character of the now famous Cortlaudt series.[1] It exhibits as well one of the most interesting examples of the contortion of mica schists on the contact with intrusive rocks which any known area affords. Here also Dr. Geo. H. Williams found the types of his hornblende-peridotite,[2] and was especially aided in his careful studies of the series. Beyond Stony Point the railway crosses the belt of blue limestome so extensively quarried at Tomkins' Cove, and then in the foot of the Dunderberg meets the main mass of the Highland Archæan. Through this it has made its way by cuts, excavations and tunneling a distance of seventeen miles to Cornwall, where it again passes off the Archæan.

[1] Am. Jour. Sci., III Series, vol. xxviii., p. 384.
[2] Ibid., vol. xxxi., p. 29.

The reconnaissance survey of Dr. Britton[1] and Mr. Merrill over this line, in connection with the New Jersey survey in 1885, brought to light some, at first sight, rather obscure dike rocks which were entrusted to the writer for determination. Their interesting character, however, encouraged further investigation in the field by him the past summer, and this has led to the following results. In the October School of Mines Quarterly (Vol. IX., p. 33), Dr. Britton has outlined the results of his work. In brief he subdivides the Archæan into a basal "Massive Group," a middle "Iron-Bearing Group," and an upper "Gneissic and Schistose Group." These members, as remarked by Dr. Britton, shade more or less into one another, nor is it always easy to sharply define the individuals. In the particular section under consideration we have especially to deal with the iron-bearing and massive members as containing the dikes, for the area which is notable for their absence is regarded by Dr. Britton as belonging to the upper Gneissic and Schistose series.

Of the dikes between Tomkins' Cove and Jones' Point the writer is prevented by the unfortunate loss of a note-book from speaking with the same accuracy of location as in regard to those remaining. There are some present, though in but few instances. One slide shows a hornblende-porphyrite very similar to one found inland and about two miles west, to be described and figured in a paper forthcoming in the *American Journal of Science* for September. This is probably an outlying dike of the Cortlandt series.

From Jones' Point to Iona Island the railway skirts the Dunderberg. The rocks are gneisses, with evident laminations that strike on the average N. 40 E. Just above Jones' Point, and at intervals for two miles to the north, they are seamed with dikes. Eleven such masses were noted. They vary from six inches to twenty feet wide, and are in almost all instances very badly altered on the exposure. In fact they weather much worse than the enclosing walls, and frequently show a recess from which the specimen has to be fairly dug out. Under the microscope enough of the structure remains to show that they were in all cases either diorites or hornblende-porphyrites, consisting either of a holocrystalline aggregate of hornblende, plagioclase and magnetite, or of a ground mass now

[1] See Rept. State Geol. New Jersey, 1886, p. 74.

PLATE XII.

Section of Dyke-rock from the Highlands.

merely a structureless alteration product with occasional cr 's of hornblende, plagioclase and magnetite. Pyrite is sometimes seen; the same is true of biotite and small prisms of apatite. The magnetite shows indications of titanium. The Dunderberg exposures are rather conspicuously contorted and broken. The strike of the laminations of the gneiss, while generally northeast, cannot in all cases be determined. The dikes seem sometimes parallel with them, sometimes notably run across them. They may or may not have experienced some or all of the metamorphic processes through which the wall rocks have passed (an idea to be more fully developed later), but the porphyritic structure would indicate the contrary. Much in the way of contact influences, if anything, cannot be detected. They are not far from the neighboring Cortlandt series. They may have been connected with it. This at present cannot be affirmed or denied.

North of the railway station at Iona Island, a belt of hornblendic schist, with great masses of hornblende and epidote, is encountered. This association is quite typical of certain localities in the Iron Bearing group, and strongly resembles the same association of the two minerals to be seen at the Todd[1] Mine in Sprout Brook Valley, northeast from Peekskill. This last is on the line of strike from Iona Island. It is not surprising, as the writer was informed by a resident, that explorations have been made in the southwest, finding, however, nothing but lean ore, too poor to work. These outcrops possibly form a "range" similar to the well-known ranges of New Jersey, with the Croft and Stuart or Sunk mines at the extreme northeast.

Between the Poplopen creek drawbridge and Fort Montgomery, is to be seen a bed of crystalline limestone or calcite, filled with rough crystalline inclusions of an undetermined mineral, probably pyroxene, and much graphite. This is in all respects similar to those noted by Dr. Horton further to the northwest,[2] although this particular outcrop seems not to have been observed by him.

At the north end of the first cut above Fort Montgomery is a very curious narrow dike of dense black rock, four inches wide, traceable twenty feet or more vertically. It runs diagonally across the laminations of the gneiss, and seems to fill a well-defined crack.

[1] Cf. Tenth Census, vol. xv., p. 90 ff.
[2] Geol. of N. Y., 1st Dist., p. 477.

Under the microscope it is seen to consist chiefly of innumerable small but well-developed hornblende crystals, having sharply defined prismatic and pinacoidal faces. They vary from 0.02 mm. to 0.05 mm. in width, and are about five times as long. The accompanying drawing (Fig. 1), from a micro-photograph, illustrates the structure. The actual field is one millimetre in diameter. With the hornblende is some plagioclase not very well developed, as the rock has more or less of a porphyritic facies. Magnetite is sparsely scattered through it in very small grains. Slides of this rock are well nigh indistinguishable from those of the diorite described by Hawes from Campton,[1] N. H., and later by Professor Harrington from Montreal, resembling[2] less closely the similar diorite described by the writer from the Forest of Dean mine.[3] Mr. L. M. Dennis, Instructor in Chemistry in Cornell University, has made the following analysis, No. 1 in duplicate. No. 2 is of the Campton dike by Hawes, No. 3 of the Montreal dike by Professor Harrington, No. 4 of the Forest of Dean by the writer.

	I. a.	I. b.	II.	III.	IV.
SiO_2	44.85	44.87	41.94	40.95	48.19
Al_2O_3	17.20	17.281	15.36	16.45	16.79
Fe_2O_3	11.20	11.04	3.27	13.47	18.37
FeO	....	....	9.89	....	....
MnO	trace	trace	.25	.33	....
TiO_2	6.578	6.738	4.15	3.39	....
CaO	7.52	7.54	9.47	10.53	6.85
MgO	5.02	4.946	5.01	6.10	1.32
K_2O	2.992	2.621	.19	1.28	1.11
Na_2O	1.390	1.611	5.15	4.00	5.59
P_2O_5	.383	.447	....	.29	....
CO_2	....	....	2.47	....	....
Loss on ignition	2.387	2.491	3.29	3.84	2.31
Totals	99.520	99.585	100.44	100.63	100.53

The discovery of this rock is interesting as showing the further occurrence of dikes of this character. On the basis of Hawes' description, Rosenbusch has made a separate type of dike rocks,[4] and called them Camptonites. Various outcrops of so-called trap dikes are recorded by the New York Survey in other parts of

[1] Am. Jour. Sci. III., vol. xvii., p. 147.
[2] Geol. Survey Canada, 1877–78, p. 439.
[3] Am. Jour. III., vol. xxxv., p. 331.
[4] Rosenbusch. Mikros-Physiographie, 2d Edition, vol. i., p. 333.

Orange county, which may prove on further examination to be similar. The writer hopes, as opportunity occurs, to add to our knowledge of them.

Beyond Fort Montgomery, except in the case just cited, no dike rocks are to be seen until Cro' Nest Mountain is reached, north of West Point. The interval is made up of gneisses, very feldspathic, and considered by Dr. Britton to belong to the Upper Schistose Series. They have peculiar feldspathic masses in them which must be considered in any question of origin or metamorphic action. Great cleavage faces of feldspar as large as the hand reflect the sunlight from the sides of the cuts. Cro' Nest and Storm King form the northern boundary of the Highlands west of the Hudson. They consist of rocks which are described by Dr. Britton[1] as quartz-syenite, and are considered as typical of the massive group. The laminations are generally apparent, but in many instances the rocks present a well-nigh massive appearance. Running like broad black ribbons in directions generally vertical, across the exposed faces are numerous dikes varying in width from a few inches to forty feet. Fifteen were noted in Storm King, six in Cro' Nest.

These dikes are very uniformly holocrystalline aggregates of hornblende, augite and plagioclose as principal minerals, with subordinate magnetite and apatite, and occasionally a little biotite, orthoclase and quartz. The hornblende and augite are generally associated, but there are instances in which each appears alone with the other minerals mentioned. The augite appears alone especially in those dikes whose wall rock is most broken and contorted. The hornblende is of the common brown variety strongly pleochroic. It is never in well-bounded crystals, but always in irregular masses, whose external shapes are conditioned by their neighbors. It frequently contains included the apatite and magnetite, and the masses vary from 0.5 mm. to 1.0 mm. in width, but are relatively somewhat longer. In the more altered specimens the hornblende tends to bleach out to a green variety. The augite is in the same irregular masses of light green color, and contains the same inclusions, but on the whole is less prone to do so. The biotite is far less abundant than the two just men-

[1] The School of Mines Quarterly, vol. ix., p. 34.

tioned, contains, however, magnetite inclusions, but in other respects shows no peculiarities worthy of note. The feldspar is in irregular masses, well twined, and contains not unfrequently as inclusions the hornblende and augite, as well as magnetite and apatite. By powdering the rock and carefully separating the feldspar by means of the Thoulet's heavy solution the specific gravity was found to lie between 2.67 and 2.70, bringing it near Labradorite.[11] The magnetite is in coarse, irregular masses, showing no indications of titanium. The apatite prisms are also quite coarse. It follows, therefore, from the relations above set forth, that, according to the well-known general law,[12] the magnetite and apatite have been first to form, and have then been taken up in the mass of the hornblende, augite and biotite in their subsequent crystallization, while the feldspar has been last of all to form, as it includes all the others. In the accompanying figure (Fig. 2), taken from a microphotograph, the structure of a typical specimen is shown. The actual field is 4.0 mm. in diameter. The different minerals, hornblende, augite and plagioclase are well indicated by their characteristic cleavages.

In the matter of classification these rocks are perhaps most nearly allied to those called by Rosenbusch Camptonites,[13] but in the matter of structure it should be stated they differ widely from the typical Camptonites in the writer's possession, for anything like a porphyritic structure is entirely lacking. Although differing from the typical and widely-known kersantites in the small amount of biotite contained, they yet, with some described varieties,[14] seem structurally related. A normal kersantite has been described from this region by Dr. Newberry,[15] which seems to form a boss in the enclosing gneiss at Croton Point.

[1] Rosenbusch. Mikros-Phys. 2d Ed., vol. i., p. 535.

[2] Rosenbusch. Neues Jahrbuch f. Min., etc., 1882, II., p. 1–16.

[3] For a translation of Rosenbusch's scheme, see the Amer. Naturalist for March and April, 1888, p. 207, etc. It is much to be regretted that Professor Bayley did not translate in this connection the German word "gang" by our English equivalent "dike." The English word "vein" is now so well understood in all the literature on ore deposits to refer to a mineral body deposited from solution, that an intrusive or igneous vein seems a misnomer.

[4] Cf. Pohlmanns. 4th Group. Neues Jahrb. Beil. Band., III., 1884, p. 67.

[5] The School of Mines Quarterly, vol. viii., p. 330, July, 1887.

In some cases these dikes are parallel to the laminations of the enclosing gneiss or syenite, in other cases cut across them. Many would seem at first sight to be interbedded masses, and the writer would confess himself inclined at first to take the view that if these mountains are to be considered metamorphosed sediments, then these dikes represent strata of composition different from the remainder. There are, however, illustrations, as stated above, of unconformability, and not only that, but of two separated and unconformable branches joining above while separated below. (Spec. 32 and 33, two dikes each twelve feet wide just south of Cro' Nest flag station.) They are, therefore, esteemed of undoubted intrusive origin.

The dikes are not infrequently faulted by feldspathic segregations. In Storm King, above the paving stone quarry, six, from four inches to eighteen inches wide, are exposed, four of which are faulted by such a segregation. The inference from this is that the dikes are of great geological antiquity. These feldspathic masses consist chiefly of very coarsely crystalline orthoclase. Such a mass we know would form only under high pressure and great heat,[1] and indicates the changes through which these rocks have passed since the dikes were intruded. The geological date of the metamorphism, if such it were, which gave these syenites or gneisses their present form, it is not easy to state, but from the comparatively unchanged condition of the strata lying against them to the north at Cornwall, it must have been before the Hudson River Period of the Lower Silurian. In the writer's opinion the dikes were intruded in Archæan time, and have experienced the same influences which have given the gneisses their bedded character. It cannot be affirmed that the dikes themselves are metamorphosed from their original structure, but it is interesting to note that they exhibit even in their narrowest examples a perfect holocrystalline structure, nor is any amorphous or porphyritic matter to be detected. We infer from this either that they were intruded between highly heated walls, and that they cooled slowly and under pressure like a plutonic rock (Tiefengestein); or else that subsequent metamor-

[1] Hautefeuille, Comptes Rendus, 1877, t. lxxxv., p. 952, idem. t. xc., 1880, p. 830. Friedel et Sarasin, B. Soc. Min., 1879, p. 158, and 1881, p. 171.

phism has recrystallized any first formed porphyritic matter. The metamorphism of igneous or intrusive rocks is a subject now attracting much attention, and has important bearing on the origin of the Archæan.[1] As for explaining the slight bedding or laminations of the wall rocks by previous sedimentary stratification, while it is not easy to adduce any positive facts against it, the writer does not believe in it. It seems most reasonable to regard the laminations as due to pressure exerted normally to them, and that the pressure was in almost all cases normal to the dikes as well.

The origin of these well-nigh massive basal rocks of the Archæan is certainly at present a most uncertain theme. Yet, although it is readily to be seen from much that has been written how easy it is to indulge in laboratory speculations which afford little else than controversial material, the writer would nevertheless advance the conclusions drawn from the structure and composition of these dikes as legitimate if not incontrovertible inferences.

SCIENCE IN UTOPIA.

BY C. L. HERRICK.

IT has doubtless been a matter of regret to many of my readers that since the publication of the valuable memoirs of Sir Thomas Moore upon Utopia no one has succeeded in penetrating the veil of mystery hanging over those happy islands.

For my own part I have often amused myself by wondering whether egress is as difficult as access and in imagining a sort of espionage of modern institutions by that conservative and self-satisfied community.

Very unexpectedly my vagaries were suddenly proven realities and I am permitted to record the results of an extended conversation with a representative and very intelligent member of the recent scientific congress of Utopia.

[1] This has been strongly advocated by Lehmann. Entstehung der Altkrystallinen Schiefergesteine. Reviewed by D. Geo. H. Williams in Am. Jour. Sci. III., vol. xxviii., p. 392.

My present purpose is simply to repeat a few facts communicated by this gentleman which seemed to me well worthy of examination if not imitation by the learned bodies of our own land. For further details the reader is modestly referred to the illustrated memoir now in preparation under the joint superintendance of my Utopian friend and the author.

These remarks must, therefore, be simply regarded in the light of a preliminary notice (Vorläufige Mittheilung) for which, by the way, I am assured there is no synonym in Utopian language or praxis.

Mr. Non[1] Nemo himself is well worthy a passing glance. Though below the medium stature of Americans he possesses a perfection of physical development not seen in the intellectual classes of our own people. Upon my remarking upon this peculiarity so disassociated in our minds with a studious habit, Mr. Non Nemo explained that in Utopia a high degree of physical perfection is demanded of public servants and candidates for admission into the ranks of the "*Geleherte*," and that such progress has been made in mastering the laws of heredity that it is rare indeed to find a case of reversion to inferior types among the children of the upper classes. Of course I eagerly inquired whether the attempt consciously to comply with the laws of heredity did not seriously impair the spontaneity of domestic and social relations. But though he admitted that there was some temporary disturbance, Mr. Non Nemo stated that the principles had become so indelibly stamped upon society and embalmed in social precedents that the compliance with the necessary regulations had become instinctive and no conscious limitation of social liberty was experienced.

The genial foreigner expressed great surprise at the general neglect of these laws in this country and went into an uncontrollable fit of laughter when he heard of the system of vicarious physical training now in vogue in American colleges. Gladly as we might linger upon these and similar topics the present occasion suggests that we must pass to the more directly scientific aspects of Utopian life.

Some incidental reference to international congresses brought out

[1] *Non* in Utopian nearly corresponds to *Von* in German or *De* in French.

many inquiries on both sides in the course of which the following facts were elicited. In Utopia during recent years the prosecution of science has enormously increased and, as usual, this increase has mirrored itself in the literature. Under the old system, which closely resembled our own, there was neither official supervision nor recognized limitation upon publication. The great mass of literature soon made specialism necessary with constantly narrowing limits, until the broader purposes of scientific study were rapidly being lost sight of in the attempt to meet the bibliographic obligations thus imposed.

Just at this juncture it happened that the continent of South America was opened to the Utopian explorers (whether this occurred before or subsequent to 1492, I was unable to ascertain, by reason of my unfamiliarity with the standards of Utopian chronology). The result was an alarming increase in purely faunal and systematic publications. The case soon became so desperate that a congress of the sciences was called to meet in the capital city which, after mature deliberation, proposed a permanent organization with the following functions and powers.

The organization was called the parliament of philosophy and is a strictly representative body, so guarded that personal jealousy among competitors can not easily exclude worthy applicants, while the financial burdens are nominal.

A council elected at the biennial session of this parliament is charged with the duties of a bibliographic bureau. In this work they receive aid from the department of state corresponding to our patent office and congressional library, here united under one management. At each session committees, appointed by the various sections, report for adoption a scheme of working classification in the department presided over by the section both as relating to the distribution of subordinate topics and the systematic arrangement of the categories of natural species.

While conformity to the scheme adopted is not binding upon authors, it forms a more or less perfect approximation to current views and is the official standard for reference during the ensuing term. This being settled, writers cannot secure recognition for publications until they have been entered in the proper department of the bureau of bibliography, which is also charged with the duty

of distributing a monthly official statement of all titles registered under the proper rubric. The expense of such a record is jointly provided for by the parliament and the general government.

In case a publication contains proposals of new species or new modifications of classification the rules further require that a separate slip bearing the name and a diagnosis in the scientific language of Utopia of each such species or modification proposed accompany the paper. These are entered under the proper head if, after examination by a special committee they are found to conform to the rules of nomenclature adopted by the parliament. If the name be imperfectly formed or duplicated the committee is directed to return to the author for correction.

The name and systematic position of each species is published in the monthly bulletin. At the next biennial session the proper sections of the parliament or committees appointed by them examine the diagnoses of species proposed during the previous term with a view to eliminate any possible synonyms. It is always understood that uncertainty stands to the credit of the proposed species. The work of this committee, my informant said, was found very delicate and there was difficulty in inducing those best qualified to serve. However, its reports are subject to revision in open section meeting and, on the whole, are most useful.

The result, continued my informant, has been to place wholesome restraint upon the professional species-maker as well as to make it possible for all conscientious students to avoid infringement on the rights of others. The fear of the scrutiny of the committee-room acts as a check on careless description, while the biennial reports periodically clears up any ambiguity. Of course there were many who felt themselves aggrieved by arbitrary decisions, but not so many as those who under the old lack of system justly complained of the freaks of fortune and the injustice of powerful rivals. The general opinion seemed to be that, in the long run, every one received a fair measure of justice from this novel parliament.

It also appears that this central organization has depositaries in all the larger cities of Utopia and in the libraries of the various learned societies and that it is becoming quite the thing for every author to send a copy of systematic papers to each of these

depositaries for convenience of examination. Some return is made by the government but just what my informant neglected to state.

I was much interested in Mr. Non Nemo's account of the adjustment of a conflict between local bureaus of research (somewhat like our state geological surveys but with a wider scope), and the official scientific commission of Utopia. This subject, however, we hope to fully elucidate in our contemplated memoir and will simply remark that the adjustment charged the local bureaus with the detailed examinations and collection of material, and imposed the duty of turning over a certain part of the facts and material to the central organization, which reduced the whole to systematic form, and included in its report an epitome of the more detailed publications of the local bureaus.

Several of the provisions described above seem to the writer adapted to the work of the Association for Advancement of Science and later to the International Congress of Sciences and, I trust, we may arrive at a satisfactory system without the long period of experiment and bitterness passed through by science in Utopia.

DESCRIPTION OF A NEW SPECIES OF FIELD-MOUSE (ARVICOLA PALLIDUS) FROM DAKOTA.

BY DR. C. HART MERRIAM.

AMONG some small mammals collected during the past season at Fort Buford, in Northwestern Dakota, by Mr. Vernon Bailey, are four well-prepared skins with skulls of a very light-colored Arvicola, a careful study of which has led to some important and unexpected results. Concerning their habits, Mr. Bailey contributes the following: "The *pallid Arvicolas* seem to be common at Fort Buford. They show a decided preference for the north side of steep hills. I have not found them on the south, southeast, or southwest sides. The only reason I can suggest for this distribution is that the twilight (their favorite hour) is longer

on the north side. The hills where I have found them are all steepest on the north side, which may have some effect, though there seems to be no difference in the vegetation on different sides. Like other Arvicolæ, they have many holes, and probably live in families or colonies, although I have not caught more than one at a group of holes; but from the difficulty in catching them this does not signify anything (have caught only four).

"Where there is grass or weeds, their holes are connected by beaten paths in the same manner as those of *Arvicola austerus*, but in many places they are in bare clay. Their food seems to consist largely of the flowers of certain plants, judging from the remains of flowers scattered around the holes, and from the contents of their stomachs and excrement. When these plants grow near, there are usually pieces of stems and blossoms of *Liatris graminifolia* adn *Artemisia frigida* lying about, but many other plants and grasses seem to be eaten. They feed largely on the seeds of *Eurotia lanata.* I found a place near their holes where something had dug down to a partly-eaten bulb of *Liatris graminifolia.* Probably these bulbs form a part of their diet, as is the case with *Arvicola austerus.* I placed corn, oats, cactus seeds, and seeds of weeds around their holes, but they remained untouched. The same was true of bread and cheese, and fried cake was seldom eaten. They seem suspicious of traps, and evidently leave their holes when traps are set near them. I have caught several grasshopper mice (*Onychomys leucogaster*) and Western white-footed mice (*Hesperomys leucopus sonoriensis*) at their holes, and think these species either drive out the Arvicolæ or else inhabit the old holes." The exact locality where these specimens were obtained, writes Mr. Bailey, "is not actually in the extreme 'bad lands,' but near the edge, where the land is about '*half bad.*' From the fact that they live entirely in the hills and usually near the tops, where it is very dry, it might be inferred that their true home is in the 'bad lands.'"

In comparing these mice with the other known North American species of *Arvicola*, two striking external differences are observed, namely, (1) *extreme paleness in coloration;* (2) *extreme shortness of tail.* The color is paler even than that of the Muskeeget Island mouse (*Arvicola breweri*), and the tail is shorter than that of any other species, not excepting *A. pinetorum*, in this respect agreeing closely with *Synaptomys cooperi.* The ears are unusually

prominent, but this peculiarity probably is subgeneric. An examination of the skulls and teeth at once shows the animal to belong to the subgenus *Chilotus* of Baird, to which but one species (*Arvicola oregonus,* from the Pacific coast region) has been heretofore definitely assigned. The range of the subgenus is thus extended more than a thousand miles to the eastward. The present species is nearly as large as *Arvicola riparius,* and consequently considerable larger than *A. oregonus.* Of the four specimens at hand, two are males and two females, all fully adult. The females bear evidence of recent nursing. The species may be easily distinquished by the following diagnosis:

ARVICOLA (CHILOTUS) PALLIDUS sp. nov.

Type no. $\frac{3852}{4431}$, ♀ adult, Merriam Collection. Fort Buford, Dakota, September 10, 1887. Vernon Bailey.

General characters.—Size medium, nearly equalling that of *Arvicola riparius* (average total length of four specimens 126.25 mm.). Tail very short (average length in four specimens 23.75

4431 male *Arvicola* (*Chilotus*) *pallidus* Merriam. From Ft. Buford, Dakota (Type). 1 and 2, skull, double natural size; 3, upper molar series, ×5; 4, lower molar series, ×5.

mm. from actual base; apparent length only about 18 mm.) with a long terminal pencil. Ears medium; thick; well haired, superior border inflexed, giving them a prominence not seen in flat ears of the same size; antitragus medium (smaller than in

A. oregonus), its anterior border becoming continuous with the anterior base of the auricle, thus forming a low rim in front of the meatus as in *A. oregonus* and *Synaptomys cooperi*. Fur everywhere long, full, and soft.

Color.—Upper parts everywhere uniform pale buffy-gray, slightly grizzled by the admixture of black-tipped hairs; under parts white, the plumbeous color of the base showing through in places on the belly; tail more or less obscurely bicolor.

Measurements of four specimens from Fort Buford, Dakota, all adults. Measurements in Millimetres.

No.	Sex.	Measured in the flesh.		Measured from the dry skin.			Date.
		Total length.	Tail to end of vertebræ.	Tail pencil.	Hind foot.	Height of ear from crown.	
$\frac{3851}{4430}$	♂	124	25	6.5	18.25	5.5	Sept. 8, 1887
$\frac{3852}{4431}$	♀	121	20	7.5		6.	" 10, "
$\frac{3853}{4432}$	♂	133	25	8.5	18.7	5.	" 19, "
$\frac{3854}{4433}$	♀	127	25	7.5	18.	5.5	" 20, "

DR. N. O. HOLST'S STUDIES IN GLACIAL GEOLOGY.

BY DR. JOSUA LINDAHL.

(Continued from July No.)

D. The moraines.—There is a marked difference between the topographical conditions of Sweden and Greenland. The latter country is all mountains. Large flat lands are nowhere to be seen, the mountains rising at once to a great altitude.[1] As a rule one

[1] A. E. Nordenskiöld: Studier och forskningar, föranledda af mina resor i höga norden, Stockholm, 1883. Pp. 63–124.

need not go very far from the coast line to reach an altitude of 1,000 feet, and peaks 3,000 to 4,000 feet high are by no means scarce. As a consequence of this topographic peculiarity the soils are here very different from those in Sweden, and particularly noticeable is the exceedingly thin layer that covers the mopentains. This is true in the same degree as the surface is more or less broken, and it is only in the narrow mountain passes that soil exists to any considerable depth. This is worth noticing in comparison with the well-known fact in Sweden that the outcrops of rock are most abundant where the land is high and broken, the explanation of which seems to be that, in a much-broken tract of ice-covered land, the lower parts of the ice must have but a slight motion, whilst its upper parts meet with but few points for their attacks.

As for the moraines of Greenland, they are essentially only ground-moraines, and inner-moraines, and, as a special form of those, one will also find border-moraines and terminal-moraines. Where the ice runs out to form ice streams, can be observed lateral moraines and, in exceptional cases, middle-moraines; these last two kinds are of minor importance.

The unmixed ground-moraine rarely comes to view, owing to its position beneath the inland-ice and under the other forms of moraines. It may, however, be observed at the side of a jökel-gate (ice-arch) or other cut in the edge of the inland ice, its characteristic features being *rounded and scratched boulders imbedded in a clayey mass of bluish color* due to the presence of iron salts of lower oxidation. It is far more common to find material from a ground-moraine mixed in among inner-moraines. Thus, at Kangarssuk and Arsuk, Dr. Holst found boulders undoubtedly belonging to a ground-moraine scattered among the more sharp-angled material of

[1] These mountains are quite often conical in shape, which has suggested the Danish name "Suckertoppen" to one of the villages of S. Greenland. The Esquimaux often apply to such mountains the name Umanak (from Umat, heart). One island with that name is located off the Arsuk fjord. It is only 600 feet in diameter, but reaches a height of 1,700 feet.

[2] The greatest altitude in Götaland (South Sweden) is found at Pustanäs in Smaland, only 1,237 feet; the highest mountain in Svealand (Central Sweden) is Städjan, 3,961 feet. The highest point in Norrland (North Sweden) is Kebnekaisse, a peak in the extreme north of the Kingdom, with an altitude of 7,194 feet.

an inner-moraine. Such occurrences become gradually more rare as one proceeds further up on the inland-ice and away from land. How the ground-moraine may occasionally form ridges on the top of the ice will be mentioned further on under the heading of *border-moraines.*

The most important moraine is the *inner-moraine.* From its location in the very mass of the ice it will gradually appear on the top as the ice melts away from its surface. It is thus generally found wherever the inland-ice borders upon land, whether this be the nunataks or the coast-lying land. Sometimes it consists of scattered stones and patches of gravel not forming a continuous covering, and then there are generally no considerable moraine deposits on the land adjacent to the ice. At other places it occurs in such abundance as completely to hide the underlying ice, giving the impression of deposits from a departed glacier rather than of a moraine still resting on the top of a glacier.

The greatest inner moraine observed by Dr. Holst was one along the southern edge of Fredrikshaab's ice-blink. It had its eastern limit close to the lake Tasek Atdlek and extended along the southern side of the ice-blink for a distance of nearly twelve miles. Its width, not far from the eastern end, was about half a mile, but the western half of it was more than a mile wide (in one place 8,300 feet), until near the western end it again became narrower. Its thickness is always greatest near land, but here it is often quite difficult to estimate its actual thickness, as it sometimes forms a compact covering, only in some fissures showing the underlying ice. This uneven thickness of the moraine-cover offers to the ice a proportionally varying protection against the sun. It thus happens that the unequal thawing moulds the underlying surface of the ice into valleys and hills, the latter sometimes rising to a height of fifty feet above the adjacent valley, and being so densely covered with moraine material that this completely hides the ice core, which, however, often forms the main part of the hill.

Farther in on the ice, the moraine gradually thins out. At the locality just referred to, the moraine-cover, 3,000 feet from land, measured several inches in depth; still the ice was seen in some bare spots. Beyond 4,000 feet from land, the moraine formed no continuous cover, and at 8,300 feet it ceased entirely, with a per-

ceptible limit against the clear ice. Only some scattered spots of sand and gravel were met with even a few hundred feet farther in on the ice. Dr. Holst estimated the average thickness of the moraine taken across its entire width near its eastern end at one to two feet. The limit between the moraine-cover and the pure ice is always located at a considerable though varying elevation above the edge of the inland-ice. In the instance of the above-mentioned moraine it varied between 200 feet and 500 feet.

The inner-moraine consists of stones, gravel and sand, mixed together. The largest blocks rarely exceed six feet in diameter, whilst by far the greatest number of them are much smaller and of a nearly uniform size. Rounded and scratched stones, derived from a ground-moraine may, in exceptional cases, be found among them, otherwise the material of the inner-moraine is characterized by its angular form, it is equivalent to the s. c. "surface-gravel," "upper boulder-gravel."

There can be but one opinion with regard to the origin of the inner-moraine. When pushing forward over higher ledges the inland-ice disintegrates the rock and carries the débris along. In its further course the ice will for some time retain nearly the same level, and the rock fragments will thus be located *in* the ice, not under it. As the ice melts away above on approaching to land this inner moraine will gradually come to the surface.

It seems proper to apply a special term for those ridge-like moraines which occur on the top of the ice, near land and parallel to it, and are met with especially in places where the land has projecting points which indent the ice; the moraines around the nunataks seem to be partially of the same character. These moraines surround the said points or the nunataks more or less in curves. Being thus confined to the borders of the inland ice they may appropriately be called *border-moraines.*

The border moraines north of the Arsuk fjord ice-river are visible far out on the sea off Ivigtut. Dr. Holst examined one that surrounds the southernmost strip of land at a distance from land of about 2,000 feet. It is not one continuous ridge but consists of several disconnected portions arranged in a semi-circle. One of these portions was about 200 feet wide and thirty-five feet high. This moraine was mainly a ground-moraine, probably forced up by some elevation of the ledge under the ice.

Another border moraine to the north of Kornok's northern ice-river, was of a different character. The stones, at least at the surface, were greatly in preponderance over the gravel. They were angular and of varying size. The moraine showed some arcuations, but taken as a whole it was parallel to the land. In some exceptional instances it approached closely to the land, even so as to touch one of the projecting points, but generally it was located some distance away from land. Its width was estimated at 100 feet, and its height at more than fifty feet; it should be remembered, however, that it might have had a core of ice. Its length was about one and a half mile. South of this moraine, and farther in on the ice, were seen three more moraines, the greatest one extending about 1,000 feet in length. Two of them were parallel, one inside the other.

Every moraine will finally be deposited in front of the glacier, and may then be called *terminal.* This term thus applied would however, be of no value. It is therefore desirable to restrict the sense of the term to such walls or osar as accumulate in front of the ice-rivers proper and generally extend across the valleys in which these rivers find their outlet. Here the moraine material gathers in such quantity and manner as to assume a character different from all other moraines. The great accumulation of material in these places does not depend on the presence of any greater quantity of such material in the ice-river than there is in the balance of the inland ice but rather on the more rapid transposition of material in these rivers.

Terminal moraines are found in front of every ice-river that does not directly run into the sea, *e.g.*, in front of Fredrikshaab's ice-blink and of the ice-rivers at Arsuk fjord and Kipissako, and of the southern ice-river at Kornok. At the last-mentioned place the terminal moraine reached a height of nearly thirty feet and surrounded the edge of the ice like the wall of a fort. At Sarkarigsok, in front of Fredrikshaab's ice-blink, were several walls, one inside the other, each about twenty feet high. The width of the total space covered by these walls aggregated about 450 feet.[3] They extended along the front of the ice-blink, both north and south, as far as the observer could see. The terminal moraines are a mixture of material derived from ground moraines and inner

moraines, sometimes mainly from the former, at other places mainly from the latter, with the addition of material from lateral moraines where such exist. Furthermore, the terminal moraines are often traversed by jökel-rivers and numerous springs which agitate and grind down the contents of the moraine. The merely local occurrence of terminal moraines and the mixed character of its contents, give to it a subordinate importance compared with the ground-moraine and the inner-moraine. Of still less importance are the lateral moraines and the middle-moraines. Of the latter kind none were observed by Dr. Holst. Lateral moraines are met with along the sides of the ice-rivers and at the foot of the nunataks. In the moraines are found some rocks not derived from the neighboring mountains. For this and other reasons, it seems evident that the lateral moraines are not altogether made up of débris from the adjacent sides of the mountains, but have received contributions from inner-moraines, and, in some instances, also from the ground moraine.

Dr. Holst calls particular attention to the fact that in Greenland the blue and the yellow clays are formed simultaneously by the action of the same inland-ice, the former near its bottom where it is protected from the oxidizing influence of the air, the latter nearer its surface; and he regards the bearing of this observation as an argument against the theory, according to which the lower blue clay and the upper yellow clay in Sweden, Denmark, and Germany, are supposed to owe their formation to two different glacial periods.

E. *The upper-drift deposits* are invariably found in process of formation in the larger valleys in front of the ice-rivers, or, in other words, along the greater jökel-rivers. Here they form more or less level plains, through which the river cuts its channel. Equal deposits are also met with in tracts from which the ice has departed, and here too their occurrence is confined mainly to the larger valleys in which once terminated greater or smaller ice rivers with jökel rivers issuing from them. The moraines from which the upper drift derives its material are partially the inner, partially the ground moraine, which first combine to form the

[1] An abundance of Diatoms flourishes in the waters between the terminal moraine and the inland-ice. In one place, at Sarkarigsok, this vegetation displayed a brilliant yellow color.

terminal moraine in front of the ice-rivers, and the material is gradually worked over by the jökel-rivers.

The force of the jökel-rivers is greatest nearest the inland-ice and diminishes as they approach the sea. In consequence, the greatest stones are found near the terminal moraine, whilst further on their size is reduced more and more until all is sand, spreading out to wide sand-plains, as is the case, for instance, off Fredrikshaab's ice-blink. The finest impalpable material is carried out into the fjords and open sea, where it forms deposits of clay.

The upper drift of Greenland shows a considerable resemblance to that of Sweden. Both are free from boulders. The gravel is assorted and stratified. The stones are well ground, although more rounded in Sweden than in Greenland. These deposits in the latter country are not unfrequently of a considerable thickness. In the bottom of the Tasiussak fjord and in a few other places they measured about 100 feet.

There are, however, no typical osar in the part of Greenland visited by Dr. Holst, who found only some smaller hills to a faint degree resembling those formations. There can be no doubt that the osar are formed near and in close relation to an inland-ice. Nothing but such ice could have transported these masses to their present locations, and nothing but the enormous force of the torrents rushing from the ice could have wrought the material so thoroughly. Still it may be less certain that the ose form has been caused in Greenland by the same agencies as those that produced glacial osar in Sweden. It may be a mere accidental resemblance and the form may depend on later excavations. Such osar were formed within the time of the melting of the inland-ice. The coast-land of Greenland presents the same character as Sweden so far that it has formerly been covered with inland-ice which has long ago melted away. Why then is it that typical osar do not exist in the said district of Greenland? Dr. Holst finds the answer to this question in the topographical differences of the two countries. He refers to his earlier discussion of the formation of the glacial osar in Sweden, a summary of which discussion was given at the beginning of this article. As stated there, such osar are formed as sediment in the beds of rivers, having cut their channels into the surface of an inland-ice. The requisite conditions for the formation of large osar

are, among others, first, that the water-divides on the inland-ice shall be sufficiently far apart so that the water supply may be sufficiently great to form larger rivers, and, secondly, that the ice shall be sufficiently free from crevasses, which would otherwise drain off the water beneath the ice instead of on its surface.

It is then evident that, in Sweden, the broad valleys and lowlands with gently rising sides must have offered particularly favorable conditions for the formation of vast gravel-osar, whilst such osar can occur only as local formations of smaller dimensions in the mountain regions of the country. It has long been supposed that gravel-osar were entirely absent from Norway. This is, however, not altogether true, but they are of rare occurrence, which fact fully agrees with the above theory. On the plains of the extreme south of Sweden, as also of Denmark and Germany, the absence of large drainage basins has hindered the formation of greater osar, although they are not altogether absent from Skane, and equivalent formations have been observed by Dr. Holst at Neustadt-Eberswalde. It is equally evident, that the topographical conditions in those parts of southern Greenland above described (page 705) do not admit of any formation of larger osar. In a country so broken and mountainous, the inland ice must be full of cracks, preventing the water from gathering to any great extent over its surface. Such cracks do not necessarily exist in a moving inland ice, and Dr. Holst mentions a smaller tract of ice between Tasek Atdlek and Kangarassuk, which was entirely free from cracks, and, as a consequence, was covered with water, which gathered into a channel five feet wide and five feet deep, in one place separating into two branches, enclosing an island of ice, before it finally rushed into a jökel-well. Also Nordenskiöld and the Danish explorers of the inland-ice met with water flooding its surface.

If the above-given reasons for the absence of gravel-osar from the mountainous part of Greenland are correct, there could have been nothing to prevent such osar from forming in the less broken tracts, f. i. the district of Holsteinborg. Dr. Holst found no opportunity of visiting that district, but after returning home he learnt from A. Kornerup's report of his travels in 1879 (published in 1881) that he had found in the Arsalik valley, N. E. of Holsteinborg, a typical gravel-ose about four miles long, parallel to the

present direction of the motion of the inland-ice, and having a roof-shaped top, and even sides, inclined 20° to 25° to the plane of the valley over which it extended in a meandering course. Mr. Kornerup also states, that the said valley is "an unusually large plain, bounded by even, gently-sloping foothills."

This observation thus fully corroborates Dr. Holst's theory.

EDITORS' TABLE.

EDITORS: E. D. COPE AND J. S. KINGSLEY.

For several years past the Peabody Museum of Archæology and Ethnology, at Cambridge, Mass., has been engaged in the exploration of the remains of the mound builders. More lately, under the direction of the Curator Professor, F. W. Putnam, it has confined its labors to the mounds of Ohio, and especially to those of the Little Miami Valley. A most careful and thorough method of work has been adopted, which has resulted in each mound investigated telling all that it could tell. Some time ago Professor Putnam informed the Bureau of Ethnology of the nature of his work, and requested that they leave him his chosen field, the Little Miami Valley, for his own exploration. This was, of course, an eminently reasonable request. He was first in that field, and had devised his methods of research, while there were thousands of other mounds which were open to other investigators. Besides, in order that the mounds may reveal as much as possible, it is necessary that all in a certain region be investigated by the same hand. With a striking disregard of scientific courtesy the Bureau of Ethnology has this year sent a party into the Little Miami Valley, thus encroaching upon the very territory which was already being explored, and explored—if the testimony of unprejudiced witnesses can be relied upon—in a more thorough manner than is the case with the rapid work of the party under the charge of Professor Cyrus Thomas. Government money should be put to a better use than this.

RECENT LITERATURE.

The Seventh Volume of the Palæontology of New York.—Another of the splendid series of monographs of the Geological Survey of New York has recently appeared, and it certainly is not inferior in interest to any of its predecessors. It contains descriptions of the "Trilobites and other Crustacea of the Oriskany, Upper Helderberg, Hamilton, Portage, Chemung, and Catskill groups, and is notable especially for the elaboration of the species of Phyllocarida, some of which are described for the first time, and many fully illustrated." This has been done by Professor John M. Clarke, to whom the preparation of the volume has been entrusted by Professor Hall. Palæontologists are familiar with the interesting discoveries made by Professor Clarke in this order. Among the more remarkable forms of which we are now afforded excellent byines, are the species of Echinocans, Tropidocans, Rhinocans, and especially the colossal *Mesothyra oceani*. Of Phyllopoda, some interesting forms are described and figured, as well as Cirripedia; while the remainder of the volume is devoted to the molluscs.—*P.*

Goode's American Fishes.[1]—This is the most comprehensive work which has yet appeared in which North American fishes are described in popular language, "with especial reference," as the title-page informs us, "to habits and methods of capture." The opportunities of its author have been unequalled, since as an officer of the U. S. Fish Commission, and as especially devoted to ichthyological science, he has been for years familiar with its work. Many of the important results of this work are set forth in the book under consideration. These embrace the determination of the nature of the migration, and time and place of breeding of many of the marine species. This subject is in the nature of the case difficult of exploration and elucidation, but a great deal has been accomplished by the Fish Commission in that direction, although much remains to be done. Among the discoveries brought to light by them may be cited the habits of that most valuable fish, the Spanish mackerel (*Scombromorus maculatus* Mitch.), which is in consequence likely to become more abundant in our markets than hitherto, through the protection which can be extended to it on its breeding grounds. The relative importance of the various food fishes is determined not only by their quality and abundance, but by their relation to

[1] American Fishes. A Popular Treatise upon the Game and Food Fishes of North America. By G. Brown Goode, Asst. Sec. Smithsonian Instn. New York: Standard Book Co., 1888, pp. 500.

other fishes, both as food and as enemies. In the former case we find the menhaden (*Brevurtia menhaden*), which, says Mr. Goode, is "by far the most abundant species of fish on the eastern coast of the United States." Millions are captured every year, without any apparent diminution of their numbers resulting. As a raptorial fish, the blue-fish may be cited. The destruction it deals in every direction is thus described by Prof. Baird: "There is no parallel in point of destructiveness to the blue-fish among the marine species of our coast. The blue-fish has been well likened to an animated chopping-machine, the business of which is to cut to pieces and otherwise destroy as many fish as possible in a given length of time. . . . As already referred to, it must be borne in mind that it is not merely the small fry that are thus devoured, and which it is expected will fall a prey to other animals, but that the food of the blue-fish consists very largely of individuals which have already passed a large percentage of the chances against their attaining maturity, many of them, indeed, having arrived at the period of spawning. . . . An allowance of ten fish per day to each blue-fish is not excessive, according to the testimony elicited from the fishermen and substantiated by the stomachs of those examined; this gives ten thousand millions of fish destroyed per day. And as the period of the stay of the blue-fish on the New England coast is at least one hundred and twenty days, we have in round numbers twelve hundred million millions of fish devoured in the course of a season. Again, if each blue-fish, averaging five pounds, devours or destroys even half its own weight of other fish per day (and I am not sure that the estimate of some witnesses of twice this weight is not more nearly correct), we will have during the same period a daily loss of twenty-five hundred million pounds, equal to three hundred thousand millions for the season."

This book gives some means of judging of the utility of the U. S. Fish Commission. As a manual for fishermen it is the best yet published, and with the "Synopsis of Fishes of North America," by Jordan and Gilbert, furnishes an introduction to ichthyology such as few countries possess.

We notice some omissions from the accounts of fresh-water fishes, as, for instance, the omission of notice of the eel, and of commensurate reference to the important food-fishes of the family Catostomidæ. We might point out a few points needing correction, but they are very few, and refer to but one, on p. 15. Dr. Estes writes of the pike-perch (*Stizostedium vitreum* Raf.): "In these waters (Lake Pepin) the wall-eye is seldom found associated with any other fish than the sand-pike. It is true, however, that in swift-rolling waters, especially under falls, we find him in company with the black bass, but I believe that the force of the fall of the tumbling waters in a measure destroy the pugilistic nature of the bass, or he would not suffer

the wall-eye to remain in his company. In other locations the bass easily drives the wall-eye from his feeding grounds." This hardly does justice to the wall-eye. In the Tennessee river and its tributaries the wall-eye is *facile princeps* of the waters, not only from his size and speed, but from his courage. He holds his resting places clear of other fishes, and feeds on the black bass when he approaches too near. I have taken two black bass from the stomach of one wall-eye, of a pound and a half and a pound weight each. The wall-eye is the best food-fish of the Tennessee and its tributaries.

This work is illustrated throughout by excellent process-cuts, of which we present three on the accompanying plate.—*E. D. C.*

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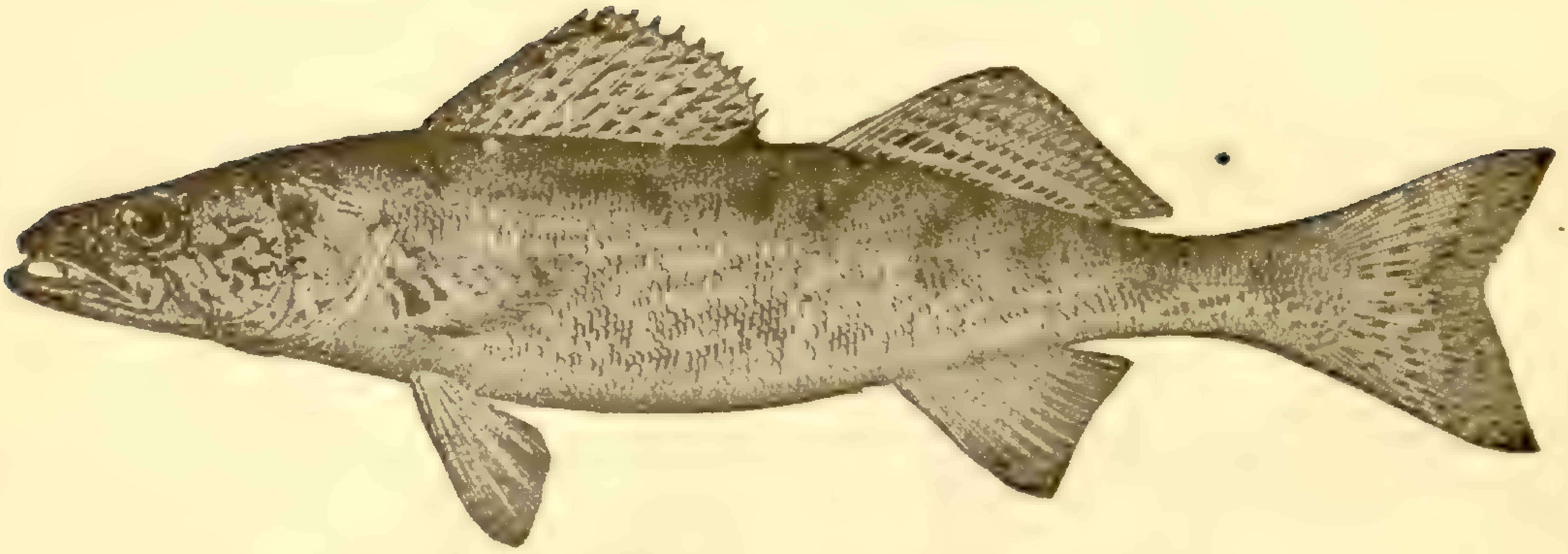
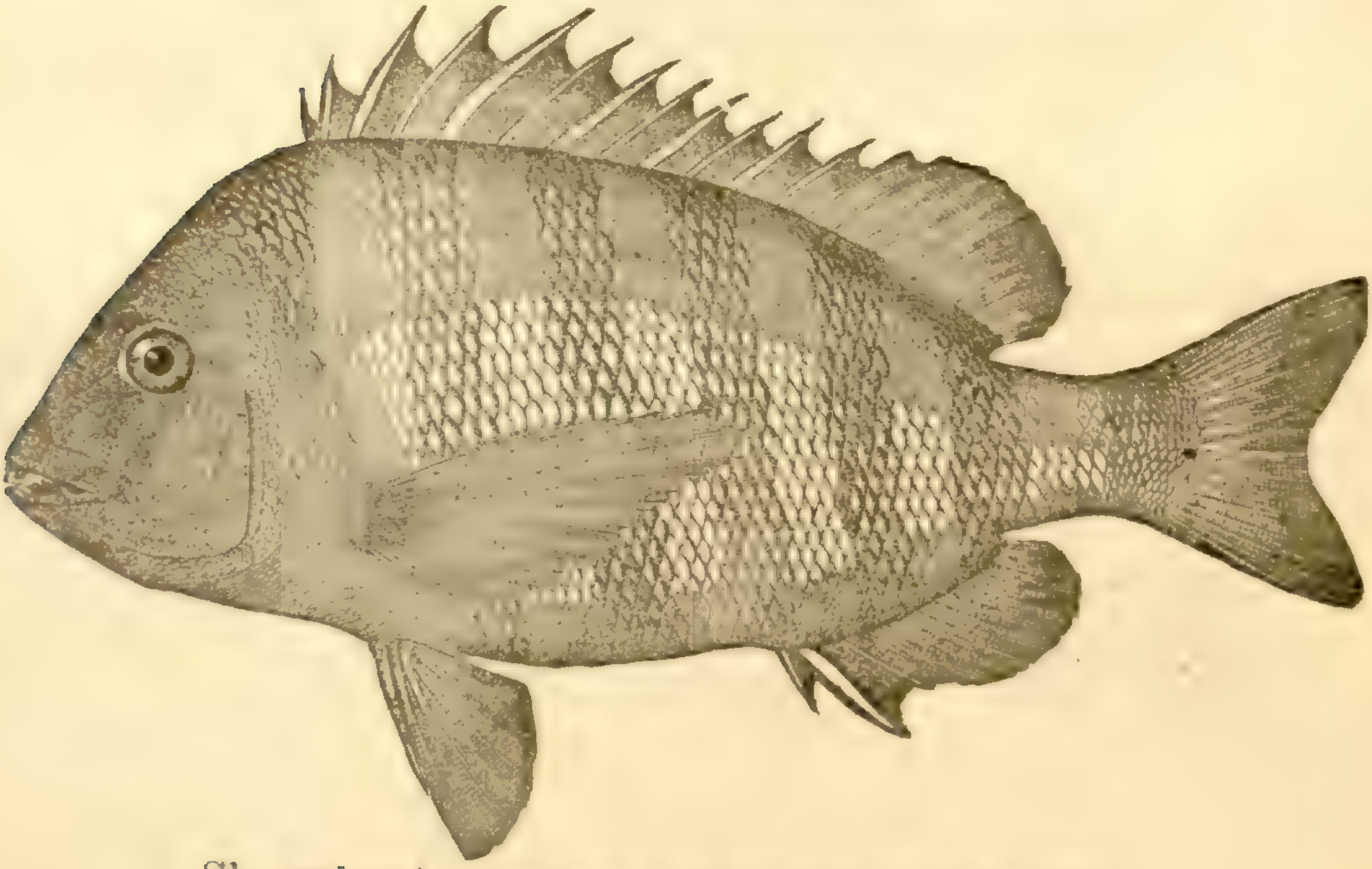
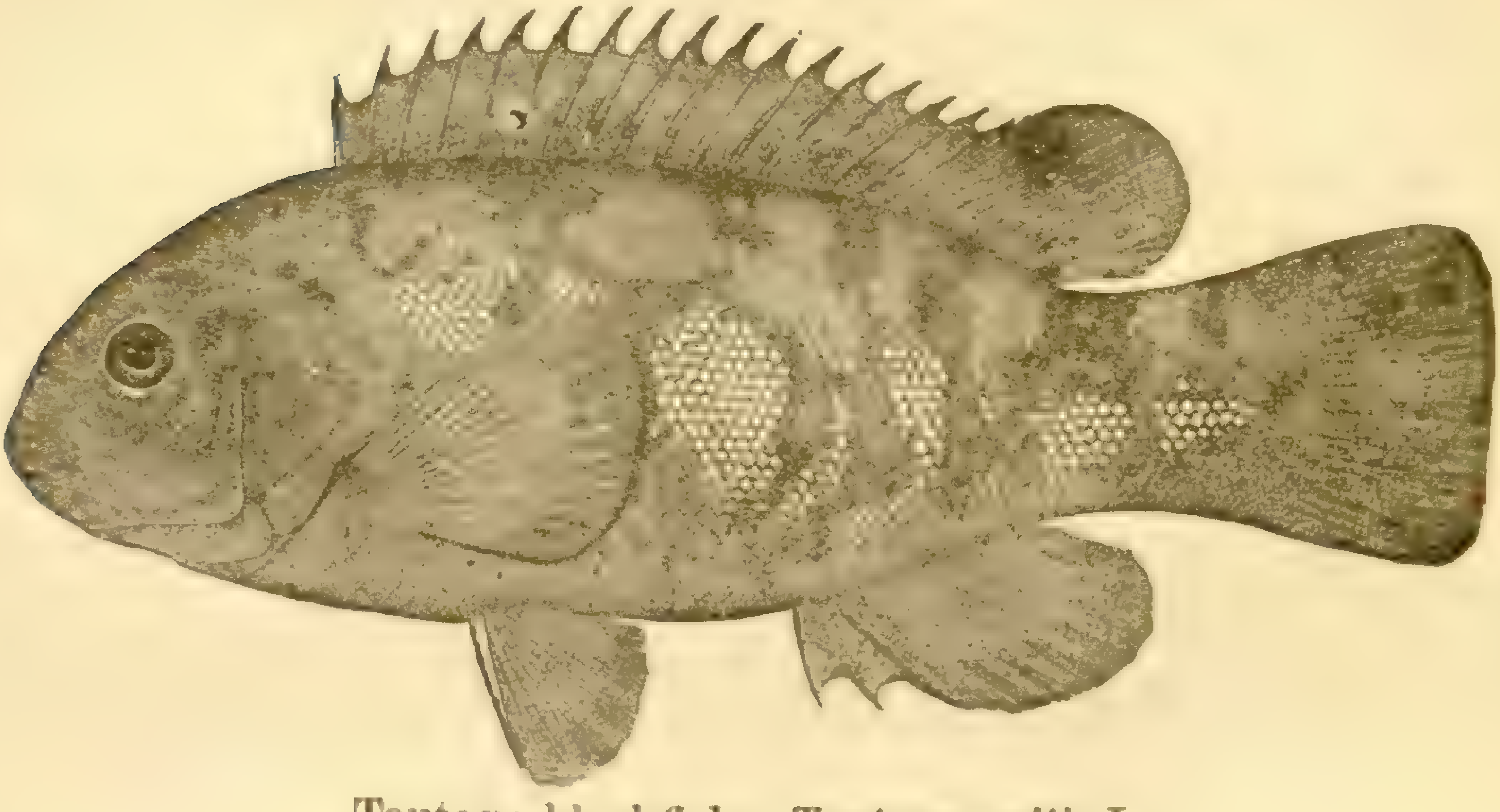
PLATE XIII.



Pike-perch; Walleye; *Stizostedium vitreum* Raf.



Sheepshead; *Archosargus probatocephalus* Walb.



Tautog; blackfish; *Tautoga onitis* L.

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GENERAL NOTES.

GEOGRAPHY AND TRAVEL.[1]

Africa.—The Cross River.—According to the agreement entered into between Germany and Great Britain, the boundary between the possessions of the former and latter power in the Cameroons district is stated to be the right bank of the Rio del Rey from its mouth (about 8° 40′ E. Long.) to its at present undiscovered source, and thence in a straight line to the rapids upon the Cross River (9° 10′ E. Long). The estuary of the Cross River is well known under the name of the Old Calabar River, and opens into the Bight of Biafra in about 8° 20′—8° 30′ E. Long. The upper part of this estuary is crowded with islands. Into the head of this archipelago Cross River enters after a most circuitous course, the general direction of which is north and south as far as about the sixth parallel north, where it trends eastward to the rapids. The settlement of old Calabar is upon a peninsula on the eastern shore of the Old Calabar estuary, between the Old Calabar and Qua rivers, both of which may be considered as tributaries of Cross River. The Old Calabar estuary is separated from that of the Rio

[1] Edited by W. N. Lockington, Philadelphia, Pa.

del Rey by the Backasey peninsula, the extremity of which is actually an island, since it is cut off from the mainland by the Little Qua River. Mr. H. H. Johnstone, H. B. M. Consul at Old Calabar, has in the early part of this year made a voyage up Cross River for the purpose of making treaties with the various kings and chiefs along its banks, as well as to settle various quarrels that had arisen among the natives themselves, and exercised a prejudicial effect upon the trade of the river. Mr. Johnstone was successful in concluding treaties with Umon (the first country above the Efik or Old Calabar country), Akukuna, and Iko-Morut, and also in inducing the people of those countries to resume friendly relations with each other and with Arun. Above Iko-Morut, and near Atam, the people are inveterate cannibals, and some of them treated their visitors to some startling, though happily bloodless experiences. At a place called Ededema, Mr. Johnstone was dragged out of the canoe by a score of cannibals, mounted on the shoulders of the biggest, and carried off at a run to the town, where he was put in a hut with the door open, and had to bear for an hour the gaze of hundreds of savages. A smoked human ham, hanging from the smoke-blackened rafters of the house, and about a hundred skulls forming a ghastly frieze around the upper part of the clay walls of the hut, served to still further heighten the interest of the situation. Yet as soon as his interpreters rejoined him a friendly conversation was commenced, and the palaver was concluded by the return of the consul to his canoe in the same manner that he had been taken from it. Incidents similar to the above occurred several times as the voyagers proceeded, and since, though all ended in friendship, it was found that at the commencement the savages were undecided whether to look upon their visitor as a supply of food or not, Mr. Johnstone deemed it advisable to return.

THE KAAP GOLDFIELDS OF THE TRANSVAAL.—The Kaap goldfields, according to Mr. F. Jeppe, comprise an area of about 800 square miles watered by the Kaap river and its tributaries. To the west this treaty is bounded by the Godwaan-berg or Kaap plateau, to the south by a high range dividing the Kaap from the Moodie goldfields, and to the north by the Crocodile River. Queen's River, the chief source of the Kaap, rises in the southern mountain range, receives the south fork of the Kaap, and then combines with it the Lampogwana or north fork near Eureka City, while the combined stream joins the Crocodile in long. 31° 25′ E., and lat. 25° 32′ S. The terminus of the Lourenço Marques railway will be established upon Transvaal territory at the junction of the Komati and the Crocodile, on the west side of the Lebombo range. The southern mountain range is a huge branch of the Drakensberg, has peaks which rise to 7,600 feet, and forms the water-shed between

the basins of the Komati and Lomati rivers and that of the Kaap and Crocodile. The Lebombo range, which forms the boundary between the Portuguese possessions and the Transvaal, is but a series of low ranges not rising above 900 to 1,000 feet. From the terminus of the Portuguese railway an east and west line is projected across the Transvaal, ascending the Drakensberg, and rising at one point to 5,884 feet. There is abundant evidence that the Kaap valley was extensively worked, centuries ago, by a white race. Quarries, shafts, tunnels, adits, the remains of well-made roads, and pits of ore lying beside them for shipment, are to be found, and it would seem that the works were abandoned precipitately. Mr. Stuart attributes these workings to the Portuguese of the seventeenth century. The valley is not considered healthful, but Barberton, the chief settlement, enjoys a salubrious climate. The lowest strata in the valley are a series of soft gray argillaceous shales, greatly tilted by volcanic action. These seem to correspond with the Silurian, and in the Drakensberg are overlaid by Devonian strata.

KUND AND TAPPENBECK'S EXPEDITION TO THE CAMEROONS.—Among the results of the above expedition are (1), the knowledge that the Beundo and Great Njong rivers have their sources above the cataract region ; (2), that the water-parting between the rivers that discharge on the coast, and those that flow into the Congo basin does not lie near the Cameroons coast, as was previously supposed; (3), that the water-parting between the left tributaries of the Binue and the rivers which water the German Cameroons region also lies far into the interior ; (4), that the racial parting between the Bantu and Sudan negroes does not lie in the direction of Adamawa, but runs in a southerly direction, and is formed by the Zannaga or Great Njong River, and lies about 145 miles from the coast ; and (5), that volcanic formations do not occur in the mountains immediately north of the Zannaga, nor in the region between it and the coast. The Beundo River discharges at Little Batanga, and is known in the interior as the Njong or Nlong, while the Great Njong discharges at Malimba by the Borea and Bornu mouths, and into the Cameroons River by the Quaqua mouth. A profile accompanying the repórt shows a coast plain about seventy feet above the sea, succeeded by a sharp slope rising to a height of 3,000 to 4,000 feet above sea-level (the Crystal Mountains), beyond which the country slopes gently to about 2,300 feet. Both rivers have a second cataract region in the interior, with a long stretch of navigable water between it and the lower cataracts. The Zannaga no doubt carries off the water of a great river region.

MOSSAMEDES AND BENGUELA.—The bed of the river Giraul at Mossamedes has, according to Mr. E. W. Parsone, for many years been dry, and though pools occur here and there in the interior, and a stream is sometimes formed after heavy rains, no water ever appears on the surface at its mouth. Yet an anchor with a heavy wooden stock has been found embedded in the ancient channel about twenty miles from the mouth. The sandstone cliffs of the coast table-land sink into the valley at about ten miles north of the port, which is larger and has a better depth of water than that of Loanda, from which it is distant 385 miles. The Bero Valley is fertile, and has some low-growing trees, but the rest of the country near the town is barren, and the want of roads and carriers hampers the trade with the interior. Colonies or inland settlements are in full working order at Sa da Bandeira, Huilla and S. Janeira, at altitudes of from 1,500 to 2,000 feet, and at these spots there is abundant agricultural wealth, but no means of reaching a market. The town of Mossamedes is regularly laid out in streets of well-built stone or brick houses, and there is a fine Government House.

Benguella is, after Loanda, the most important commercial place upon the southern part of the West African coast, since its import and export trade is four times that of Mossamedes. The trade with the interior is nearly all done at Catumbella, about twenty miles in the interior, and thus Benguella itself has a suburban appearance, the houses having large grounds, and the streets forming broad, tree-planted avenues. Catumbella and Benguella are connected by telephone, and this instrument is in general use. Carriages, buggies, and bicycles have also penetrated to this African town. A preliminary survey has been made for a railway into the interior, to Caconda, distant about 120 miles from the sea, and thence to Limbigues and Bihe. These highland places are fertile, healthy, and adapted for cattle-breeding. A superior class of rubber gum has been recently introduced by the natives, and, as the caravans, which formerly took nine months to fetch their loads, are now back in three months, it is supposed that a new gum-bearing bush or shrub has been discovered.

AMERICA.—FERNANDO NORONHA.—The July number of the Proceedings of the Royal Geographical Society contains a map of Fernando Noronha and its adjacent islands, to illustrate the account of the Rev. T. S. Lea, who was a volunteer companion of Mr. Ridley and Mr. Ramage in their exploration of the little group in 1887. The total length of the group is about six and a quarter geographical miles, and the main island is about a mile and a half in width. The northeast cape of Rat Island is precipitous, but the rest slopes to the westward, and is apparently cultivable. The

mass of the group is volcanic, consisting of basalt and phonolite, but Boobie Island and Egg Island are raised masses of reef rock, which occurs also upon the basalt of Platform Island, and on the southern beach of Rat Island. Mt. St. Michael is a phonolite peak 385 feet high. The Peak (El Pica), is a huge mass of columnar phonolite, with a talus or débris around it. Two other phonolitic masses stand like bastions on the south coast, separated by a ridge of basalt. As the group is surrounded by deep sea, and nothing volcanic occurs near it, Mr. Lea is inclined to think that it marks the site of an isolated vent. The islets of the southern coast are, with one exception, composed of phonolite. Where the phonolite and basalt join, both, especially the former, are more or less disorganized in structure. The Sapate, or southwestern heights of the main island, are basaltic. Three-quarters of the insects taken by the expedition were new to science, and of the three reptiles an amphisbæna and a lizard are peculiar, as are two of the three land-birds. About 200 species of plants were found, some thirty of which were peculiar. Invading plants have mastered the plains, and are gaining the heights and the sea-shore. On the East Hills were found two scrambling bushes of a strange plant which seemed to be the last of their race. Few of the native plants have conspicuous flowers, and many are berry-bearing shrubs, Euphorbiaceae, and grasses. But the flora includes a new dodder, an endemic fig, and two species of Oxalis, also a new Convolvulus. Out of the human population of rather over 2,000, about 1,400 are convicts.

Geographical News.—The census of Paris for 1886 gives a population of 2,260,945, out of whom 1,802,53 are foreigners—nearly eight per cent. As this does not include foreigners passing through Paris, the alien per-centage present at any one moment is really still greater. This foreign population consists chiefly of Belgians, Swiss and Hollanders. The number of births in the city decreases with each successive year. In 1887 the total number of births was 60,666, and the excess over deaths only 5,820.

The population of Melbourne is now estimated at 400,000, or two-fifths of the total population of the colony of Victoria, and one-seventh of that of the whole of Australia.

The Argentine Republic contained in 1887 a population of 3,935,286. Nearly 4,000 miles of railroads are in operation, and the conceded lines extend over nearly one and a half times as much territory.

M. Ant. de Abbadie has found the sources of the river Hawash at the foot of Mount Ilfata, at the end of the Meca range, and on

the summit of Mount Dandi he has found a double lake of considerable extent and depth, shaped like the figure eight. An affluent of the Gudar issues from this lake. He also discovered a deep lake, with most beautiful surroundings, at the foot of the immense crater mountain called Mt. Harro. A stream from this Lake Wancit joins the Walga, which rises on the summit of the mountain.

According to the Consular Report for 1887, the population of Java and Madura in 1886 was 21,997,259, showing an increase of 1,065,605 since 1884. The exports of cinchona are increasing.

Late measurements of the heights of the Austrian Alps have reduced the Marmolata, the highest dolomite, from 11,464 feet to 11,016 feet, have shown the Antelao to have 10,874 feet, and place the Cima di Vezzana at 10,470, and the Cima della Pala at 10,454. The former of these peaks must therefore be regarded as the loftiest of the Primiero group, the remaining peaks of which gain or lose only a few feet by the new survey.

GEOLOGY AND PALÆONTOLOGY.

OSBORN ON THE MESOZOIC MAMMALIA.[1]—In this essay we have a comprehensive and minute study of the Mesozoic Mammalia, based on the existing collections of the world. First among the latter is that of the British Museum; then that of Yale College; then those of Prof. Cope, of the Philadelphia Academy and of William's College, Mass. The results obtained are of the greatest interest and importance to the question of the origin of the Mammalia. Professor Osborn has undoubtedly given the only analysis of the dental characteristics of these types, which we have; and as a consequence we can form a much better idea of their systematic and phylogenetic relations than has been hitherto possible. The results of the research are summarized as follows: First, Traces of Reptilian structure are only observable in the Triassic genera Dromotherium and Microconodon, which Prof. Osborn accordingly places in a new order, the Protodonta. Second, The close parallelism of the American and European genera, and of species of the latter country and South Africa. Third, The diversity of the dental types of the genera, and the specialization of some of them. There are six or seven wholly distinct types of dentition.

[1] The Structure and Classification of the Mesozoic Mammalia. By Prof. H. F. Osborn. From the Journal Academy Natural Sciences of Philadelphia. [2] Vol. IX., pp. 186–265. July, 1888.

Professor Osborn regards the Multituberculata as a distinct series, and considers their reference to the Monotremata to be an open question. Of the remaining types he refers a part to the Marsupialia, under the name Prodidelphia (Hæckel), and the position of the remainder he leaves in doubt, placing them provisionally in the Insectivora. The dental characters of the Multituberculata are tolerably uniform, but the case is different with the two other divisions. In the Prodidelphia there is a carnivorous and omnivorous sub-group, with three well-defined families; and a herbivorous sub-group, including only the remarkable family Kurtodontidæ, based on the single genus Kurtodon, which was discovered by the author himself. Of the possible Insectivora there are two families. The families proposed appear to be well defined.

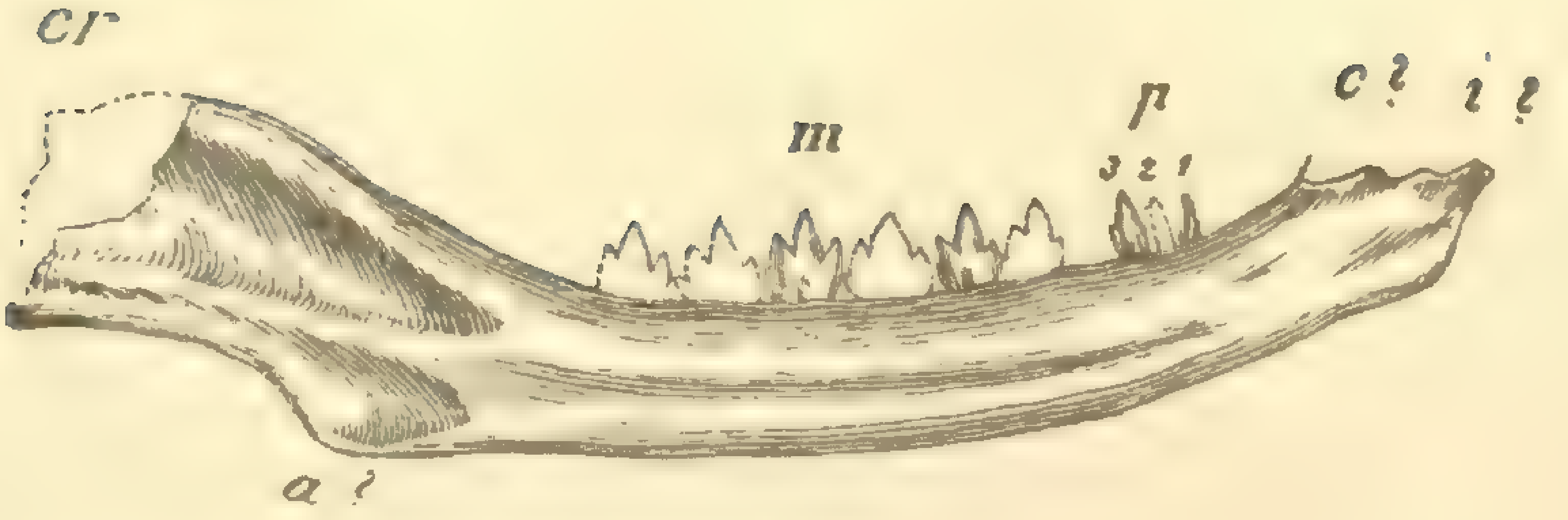
In analyzing the dental characters, Prof. Osborn follows the lines laid down by the author of the present review. He also finds the phylogenetic deductions made by the same author to be sustained by his investigation. Between the simply conic (haplodont) and the complex crown (lophodont) he finds the series to be triconodont, tritubercular, tuberculo-sectorial (lower), and quadritubercular. He confirms the view that the tritubercular has been produced by the rotation outward, in the upper jaw, and inward in the lower jaw of the anterior and posterior cusps of the triconodont crown. Prof. Osborn names the principal cusp the "protocone," and the anterior and posterior cusps "paracone" and "metacone," respectively. Among Mesozoic Mammalia we have the first three of the above types represented, together with a half-prismatic type in Kurtodon Osb., besides the Multituberculata.

This memoir was long in press, and has grown by a process of accretion; hence there appear some unavoidable irregularities of classification of its contents. A foot-note we observe is liable to misconstruction (p. 245), where it states that Dr. Harrison Allen first demonstrated the modification of the tritubercular into the quadritubercular molar crown. Dr. Allen demonstrated the possibility of this history by an acute study of the homologies of the cusps, but he did not demonstrate it ontogenetically or phylogenetically. We have but one serious criticism to make of this memoir. This is the almost universal introduction of specific characters into diagnoses of genera. Examples of this are seen on p. 216, where all the characters in the generic diagnoses except one or two are only specific.

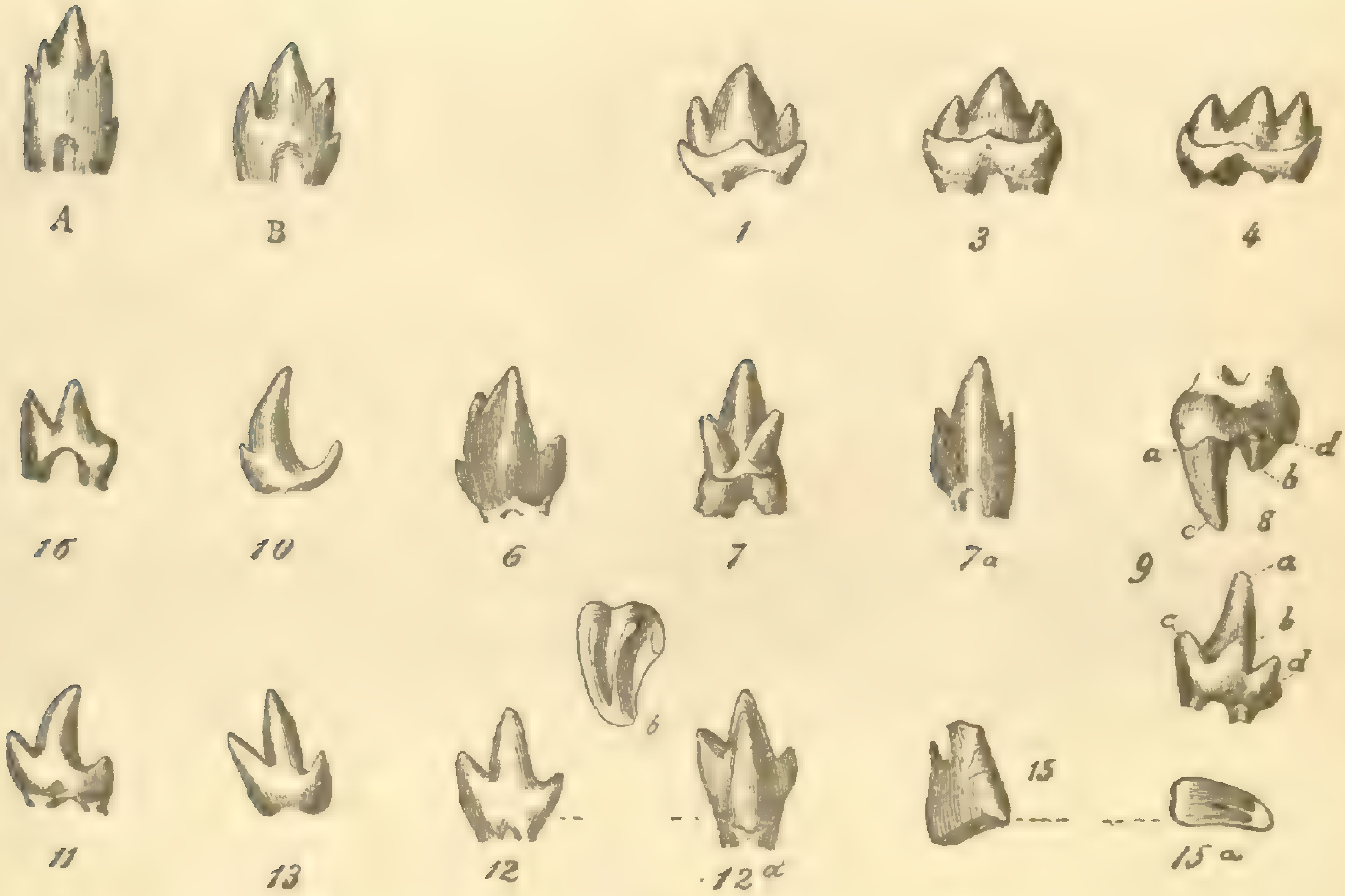
This memoir is illustrated by numerous excellent cuts, and by two plates. Two of the cuts are here reproduced.—*E. D. Cope.*

Lydekker on the Ichthyosauria and Plesiosauria.—In two late numbers of the *Geological Magazine* of London, Mr. Lydekker publishes reviews of the English species of the two

PLATE XIV.



A



B

FIG. A.—*Microconodon tenuirostris* Osborn ; outer face of right mandibular ramus, four times natural size.

FIG. B.—Principal molar tooth-forms of the Mesozoic Mammals of the second Group. The anterior face of the molars throughout is to the left, and the posterior face to the right. A, *Dromotherium*, second inferior molar, inner face, × 7. B, *Microconodon*, the fourth lower molar, outer face, × 7. 1, *Amphilestes*, the second lower molar, inner face. 3, *Phascolotherium*, the fifth lower molar, inner face. 4, *Triconodon*, the second lower molar, inner face. 6, *Peramus*, the fourth lower molar, outer face. 7, *Spalacotherium*, third lower molar, inner face. 10, *Leptocladus*, third lower molar, outer face. 11, *Phascolestes*, third lower molar, inner face. 13, *Achyrodon*, fourth lower molar, outer face. 12, *Dryolestes*, lower molar, inner face; *a*, outer face; *b*, wearing surface. 15, *Kurtodon*, upper molar; *a*, wearing surface.

orders above named, which will be of much use to students. He admits three genera of Ichthyosauria, viz.: *Ophthalmosaurus* Seeley (*Baptanodon* Marsh), *Ichthyosaurus* Conyb, and *Mixosaurus* Baur. He does not find any reason to subdivide the genus Ichthyosaurus. Of Plesiosauridæ he admits the genera Plesiosaurus, Thaumatosaurus, Pliosaurus, and Elasmosaurus (under the name Cimoliasaurus), but does not include in the last named the Jurassic species which have the same structure of the shoulder-girdle, which Seeley described under the name of Colymbosaurus several years ago. We find this course inconsistent, and believe the principles adopted by Seeley in his classification of the Plesiosauridæ to be well founded, except as to the genus Muræenosaurus, which Mr. Lydekker shows to be a synonym of Colymbosaurus. Mr. Lydekker falls into the error of supposing that the genus Polycotylus is principally characterized by the cupping of the vertebræ. The fact is, that the structure of the paddles is as different from that of Plesiosaurus, as that of Ichthyosaurus is from Mixosaurus, and in much the same way.

Mr. Lydekker in one of these papers formulates his reasons for his habitual inconsistency in the matter of taxonomy, by saying that in his opinion generic discriminations are "simply a matter of convenience." We hold a different view, in common, as we believe, with most taxonomists, which we have stated elsewhere. We will content ourselves now with observing that we find the method of Mr. Lydekker a matter of *inconvenience* rather than of convenience. We must also once more protest against being misquoted by Mr. Lydekker. He says (*Geol. Magazine*, Aug., 1888, p. 356), "We may notice Professor Cope's restoration of the so-called *Elasmosaurus platyurus*, given in the *Transac. Amer. Philos. Soc.*, Vol. XIV., pt. i., pl. ii. In this instance the head has been placed at the extremity of the tail," etc., etc. On this I must observe that no such plate appears in the *Transactions of the American Philosophical Society*, or in those of any other Society. Of this Mr. Lydekker can easily satisfy himself. It is true, however, that an error got into the first descriptions of that species (see *Proceed. Boston Society Nat. History*, 1869–70), but it was done in imitation of the precedent laid down by the describer of the species named Cimoliasaurus (a name which Mr. Lydekker wishes to adopt) several years earlier. Here the cervical vertebræ were described as caudals. This mistake was corrected by its author after an inspection of the skeleton of Elasmosaurus. The plates and descriptions published by the American Philosophical Society are also correct, and the genus Elasmosaurus is there for the first time fully characterized. The supposed genus Cimoliasaurus was never characterized by the author of the name.

We suspect that if we were to state that Mr. Lydekker had described the bones of a crocodile as those of an ostrich, and the teeth of a baboon as those of an ape, without at the same time stating that he had himself corrected those errors, he would not consider our method of criticism legitimate.[1] And if we were to assert that in description he called the inside the outside, when he had not done so,[2] and stated that a scientific body had published a plate which it did not publish, he would consider us wanting in a primary essential of criticism, viz., accuracy.—*E. D. Cope.*

Bibliographical Notes on the Two Books of Conrad on Tertiary Shells.—Having had occasion to see various copies of T. A. Conrad's "Fossil Shells of the Tertiary Formations" and "Fossils of the Tertiary Formations," I have found that nearly all of them in some respects are deficient. In fact, I have not seen a single copy that gives perfectly all that has been published in the way in which it had been issued, and one finds in the literature quite a number of assertions which show an erroneous or imperfect knowledge of these two works.[1] For this reason I consider it desirable to give the following notes:—

1. "Fossil Shells of the Tertiary Formations of North America." The two most complete copies which I have seen are those in the library of the Academy of Natural Sciences and my own. Neither is perfectly complete, but both together furnish the following data:—

The book has been issued in two editions, the second edition being a supplement to the first one. The first edition has been issued in four parts.

First edition: Part I. Pages 1 to 20, plates 1 to 6. Yellow cover, with date October 1, 1832. There is nothing printed on the back of this cover.

Part. II. Pages 21 to 28, plates 7 to 14. Yellow cover, with the date December, 1832; a note by the author on its fourth page.

[1] American Naturalist, 1888, p. 165.

[2] We suggest whether Mr. Lydekker has not referred, in the addendum to the V. Vol. Catal. Fossil Mammalia Brit. Mus., a species of Tragulidæ to the Bovidæ and to the genus Tetracerus. We did not allude to this in our review of this volume, thinking the author would correct it himself.

[1] For instance, owing to a deficiency of his copy of the "Fossils of the Tertiary," Professor A. Heilprin says: "Fulgur maximus Conrad, Fossils of the Medial Tertiary Formations, plate 47, not described." (Explorations on the West Coast of Florida, p. 72.) Conrad, however, described this species twice, first on the cover of the second part, then on page 83. Compare also the statements in White's Bibliography of North American Invertebrate Palæontology.

Part III. Pages 29 to 38, plates are mentioned in the text, but none have been published. Yellow cover, with the date August, 1833; on the fourth page there is a note that the plates will be published with No. 4.

Part IV. Pages 39 to 46. No plates. Yellow cover, with date October, 1833; on the fourth page a note signed, "T. A. Conrad, Claiborne, Alabama, November 1, 1833."

Second edition: Pages numbered 29 to 56, plates numbered 15 to 18. One colored geological map of Alabama. Blue cover, the title-page of which gives the date: "Republished with plates, March 1, 1835."

2. "Fossils of the Tertiary Formations of the United States." The book is sometimes quoted as "Fossils of the Medial Tertiary of the United States," on account of the title-page of two of its parts. The following notes are also based on the copy in thelibrary of the Academy of Natural Sciences and my own copy, which supplement each other.

The introduction is numbered V. to XVI.; the rest is numbered 1 to 89. There are forty-nine plates; some of them are without a number. The book has been issued apparently in three parts The cover of the second part contains quite a number of descriptions.

Part I. Pages 1 to 32, plates 1 to 17. The brown cover is without a date, and gives the title: "Fossils of the Medial Tertiary of the United States." The fourth page contains the descriptions of four species.

Part II. Page 33 to 56, plates 18 to 29. The brown cover is also without a date, and on the title-page is also printed, "Fossils of the Medial Tertiary," etc. The other three pages contain quite a number of descriptions, among them the same four species, which are described on the cover of Part I.

Part III. Contains apparently the rest of the book; pages 57 to 89, plates 30 to 49. The brown cover is also without date, but gives the title: "Fossils of the Miocene Formation of the United States."

Regarding the date of issue of the different parts of the "Fossil Shells," and the authorship of Part III. and Part IV., nothing need be said here. Regarding the date of issue of the "Tertiary Fossils," the following may be stated:—

The cover of Part I. of the Academy's copy bears in Conrad's handwriting the date "January, 1838."

The cover of Part II. of my copy is marked with ink in Conrad's handwriting, "May 7, 1840."

The cover of Part III. of my copy is marked in the same way by Conrad, "January 1845."—*Otto Meyer, Ph.D.*

CHALICOTHERIUM AND MACROTHERIUM.—M. Henri Filhol has recently made a discovery of remarkable interest in the beds of Sansan, of the middle Miocene of France. It removes, in the first place, what has long been an enigma, that in three separate miocene deposits, those of Sansan, Eppelsheim and Pikermi, the limbs of one genus are very numerous with no trace of the skull, while the skulls of another genus of about the same size have never been found with the limbs. The discovery that Chalicotherium represents the skull of the long-known skeleton of Macrotherium, the one a supposed ungulate, the other a supposed edentate, is so astonishing that one can hardly credit it at first. M. Filhol himself, however, found the skeleton, which is almost complete, with the skull *in situ*, so that there remains little or no doubt that they belong together, and he now has an extensive memoir in preparation giving the complete characters of the animal. The peculiarity of *Macrotherium* and the more recent *Ancylotherium* is the deep grooving of the terminal phalanges as in the sloths. This, taken with the modification of the middle phalanges and the rotation of the fore and hind feet upon the outer side, with the shortening of the inner toes, is so strikingly edentate, that attention has been entirely drawn away from the upper bones of the hand and foot. When, however, one examines the carpus and tarsus, with the perissodactyl affinities of the molar teeth in mind, it immediately appears that this is a well-marked perissodactylic type, closely resembling that of Palæosyops, in the tarsus, especially. After an examination of the feet in the collection of the Jardin des Plantes, no doubt remained in my mind of the association of Chalicotherium and Macrotherium. Without anticipating M. Filhol's memoir I may note a few of the Perissodactyle characters of the tarsus. The calcaneum has a long neck and broad internal extension, which is lacking in the edentates, for articulation with the astragalus. The latter bone is much like that of some species of *Aphelops* with the neck very short; it has a broad facet for the cuboid. The cuboid has a postero-internal extension which is also found in *Palæosyops*. The cuneiform is very highly modified, being reduced anteriorly to a thin shell. The third metatarsal abuts against the cuboid, the second against the external cuneiform. In short, remove the phalanges, widen the navicular, and lengthen the middle instead of the second metatarsal and you have a true Perissodactyle tarsus. The carpus is equally so, but is much less characteristic. Turning to the skull, we find of course the teeth of the *Palæosyops* type. I think there is an alisphenoid canal. There are other non-perissodactyle characters; there is no third trochanter of the femurand, as M. Filhol points out the arrangement of the skull is very different. The tympanic bones are also largely developed and of a unique shape. The question remains, what is this animal?

M. Filhol's restoration showing the long fore limbs and short hind limbs, and feet resting partly on the side, demonstrates that it had the habits of the sloths. He also informs me that the older individuals retain only one incisor. On the other hand the structure of the carpus, tarsus, skull and teeth, is in so many features so strikingly Perissodactyl, that there seems to be no alternative except to leave *Chalicotherium* in this order and regard it as an aberrant form, with nearest affinities to Palæosyops and genera of that line.—*Henry F. Osborn, Paris, September 1st.*

Geological News.—General.—Mr. Mellard Reade and Mr. Davison have recently pointed out that, owing to the cooling and contraction of the earth, there is at some depth beneath the surface a zone of no stress, that is to say, where the compressive stress due to the radial contraction of the sphere, and the tensile stress due to the circumferential contraction of each zone, are equal. Prof. C. L. Morgan (*Geol. Mag.*, 1888, p. 296) asks, "Is it not possible that throughout the zone of maximum tension, due to circumferential contraction, the rocks may be rendered fluid by relief of pressure?" With regard to mathematical calculations upon the depth of this viscous or fluid zone beneath the surface, Prof. Morgan truly remarks that "numerical calculations in these matters are only too apt to mislead by throwing a glamour of apparent mathematical accuracy over problems concerning which the most noteworthy feature is our profound ignorance."

Cambrian and Silurian.—The Palæontological Department of the Swedish State Museum has published a list of the Cambrian and Lower Silurian faunas of that country, by Prof. G. Lindstrom, and another of the Mesozoic fauna, by Prof. B. Lundgren. The Cambrian is divided into (1) the Eophyton and Fucoid Sandstones, (2) the Paradoxides beds, (3) the Olenus Schists, and (4) the Dictyonema Slate. One hundred and fourteen species are enumerated from this formation. The Lower Silurian comprises 1, Ceratopyge Limestone; 2, Lower Graptolite Schists; 3, Orthoceratite Limestone; 4, Middle Graptolite Schists; 5, Chasmops Limestone; 6, Trinucleus Schists; 7, Brachiopod Schists; 8, Upper Graptolite Schists; and 9x9, Leptæna Limestona. The species enumerated from the Lower Silurian number 627.

Carboniferous.—It appears that the peculiar rock called chert consists mainly of the spicules of sponges. Dr. G. J. Hinde has found it to be thus composed in the Yoredale series of Yorkshire (Eng.), in Wales and in Ireland, while in the June issue of the *Geological Magazine* he describes the character of the sponges of the chert and siliceous schists of Spitzbergen. The Permo-Carbonifer-

ous series of the west and southwest shores of Spitzbergen is over 200 m. in thickness, and is divided by Dr. Nathorst into the Ursa Sandstone, regarded as Devonian, the Cyathophyllum Limestone, the Spirifer Limestone, and the Productus Chert. This series is not followed by grits, sandstones, and coal-measures, but by shales, marls, and sandstones containing an exclusively Permian fauna, and the series itself, though as a whole regarded as stratigraphically equivalent to the Carboniferous Limestone, contains a certain mixture of Permian fossils. The Productus-chert consists of beds of chert composed largely of disintegrated siliceous sponges, but rich also in Producti and other calcareous fossils, and of intercalated siliceous beds consisting of minute grains of quartz, but rich in sponge spicules. The cherty rocks, unlike those of Yorkshire and North Wales, have yielded entire forms of sponges, which have been described by Dr. E. von Dunikowski.

Dr. R. H. Traquair (*Geol. Mag.*, 1888, pp. 251–254) describes three new species of Palæoniscidæ from the English Coal-Measures. The article is the second contribution from Dr. Traquair upon this subject, the first being contained in the December issue of the same magazine for the year 1886.

In the July issue of the *Geological Magazine* Mr. A. C. Seward comes to the support of Prof. Williamson's remark that the specific names and definitions of Calamites are probably worthless, with a figure and description of a specimen which upon one side shows the characters of *C. undulatus*, while the other side of the same cylinder has narrow and equal ribs.

Dr. Schweinfurth has discovered Lower Carboniferous beds in the Arabah valley of Upper Egypt, opening out into the Gulf of Suez. He recognizes the identity of the beds he describes with those of the Wadi Nasb in the Sinaitic Peninsula; the genera are in most cases identical, and the species characteristically Carboniferous.

Mesozoic.—Of the lower portions of the Mesozoic series only the Rhaetic and Liassic strata are developed in Sweden, and not more than twenty-four species are enumerated by Prof. Lundgren from the former and 129 from the latter group. There is then a wide gap in the middle portion of the Mesozoic, until the higher members of the Cretaceous are reached. These are highly fossiliferous, the list comprising 456 species.

Jurassic.—Mr. R. Lydekker (*Geol. Mag.*, 1888, p. 309) restricts the genera of Ichthyopterygia to three, viz.: Ophthalmosaurus, Ichthyosaurus, and Mixosaurus, the last the least specialized. I

tenuirostris and its allies are the forms most nearly allied to Mixosaurus Baur, and *I. tenuirostris* has only four digits. From this Mr. Lydekker agrees with Dr. Baur that the Ichthyosaurs have descended from a tetradactylate ancestor. Two additional species, *O. cantabrigensis* and *I. conybeari*, are described, the former from the Greensand of Cambridge (Eng.), the latter from the Lower Lias.

"The Insect-world of the Lithographic Shales of Bavaria" is the title of an extended article in Volume 34 of *Palæontographica*, by P. Oppenheim. Among the fossils described are *Cyrtophyllites rogeri*, a new genus and species of Locustidæ, two new species of Ephemera, *Prolystra lithographica*, *Eucicada microcephala*, *Ischyopteron suprajurense*, n. gen. *et* sp.; Halometra, a new genus of Hydrometridæ, with two species; three species of Carabidæ, a Prodytiscus, two forms of Lamellicornia, two of Clavicornia, three of Sternoxia, one of Rhynchophora, and three of Chrysomelidæ.

CRETACEOUS.—A. S. Woodward (*P. Z. S.*, X. Feb. 21, 1888) shows that the lateral line of *Scyllium sahelalmæ*, from the chalk of Mt. Lebanon, was supported by a series of half-rings, exactly like those met with in Squaloraja and the Chimæroids. The canal of the lateral line was thus presumably an open groove; a condition which obtains in only two living Selachians, Echinorhinus and Chlamydoselachus.

Squatina cranei is the name given by Mr. S. Woodward to a species of "angel-fish" discovered in the chalk of England, and distinguishable from the species of Squatina already satisfactorily known by the great relative size of the spinous dermal tubercles. No defences of this kind have been found in extinct forms, and the existing species has them much smaller in proportion to the size of the fish.

The same geologist also describes certain specimens of mandibles of the singular *Belonostomus cinctus*, revealing the precise character of the dentition, and the relations of the bones. The two rami occupy only half the entire length of the jaw, the anterior half being formed by the enormously elongated pre-symphysial bone. The narrow and deep rami meet at a very acute angle; the symphysis is elongate, gradually diminishing to a thin edge below, and the large pre-symphysial bone, which is a median unpaired element is articulated to the sloping triangular surface thus formed. On the latter bone there is a median row of about thirty large conical teeth, while a great number of smaller similar teeth—the largest little more than one-sixth the height of the largest of the median series—are placed irregularly upon the lateral margins of the bone.

MINERALOGY AND PETROGRAPHY.[1]

Petrographical News.—The sanidinite bombs from San Miguel, one of the Azores group of islands, are regarded by Paun[2] as the first products of the crystallization of the magmas from which the existing phonolitic and trachytic rocks resulted, and not as altered pieces of some foreign rock caught up by the magma in its passage to the surface of the earth. They are coarsely crystalline aggregates of sanidine, augite, with which are associated other less common minerals, as pyrrhite, azorite and lavenite. The sanidine is intergrown with albeite lamellæ having the position of the dome 13 $P\overline{\infty}$. The hornblende is similar to arfredsonite in composition, and has an extinction of about 34° in plates parallel to the clinopinacoid. The lavenite has all the properties of this mineral as described by other writers.[3] Its extinction on the clinopinacoid is 21°. The little hyacinth-red octahedra of *pyrrhite*, which were regarded by Hubbard as probably belonging to a titanate, were isolated and found to be crystals of a niobate related to pyrochlor or koppite. The *azorite* was analyzed, yielding: ZrO_2 = 66.3%; SiO_2 = 35.3%—very nearly the composition of zircon.—In a brief synopsis of a paper now in course of publication in the *American Geologist*, Mr. Haworth[4] communicates some interesting notes on the Archæan rocks of Missouri. In a diabase porphyrite, from Madison county, are areas of quartz, which seem to be the remains of porphyritic crystals, whose original outlines have been destroyed by the corroding action of the diabase magma before its consolidation. Since an analysis of the rock reveals a content of only 53.4% of silica, it would seem that we have another[5] instance illustrating the possibility of the separation of free silica from a very basic magma. In another porphyrite the rare rock constituent piedmontite was detected. A very instructive fact in connection with the Missouri rocks is the existence of granites of idiomorphic orthoclase crystals which have been enlarged by the addition of orthoclase material. In some cases this enlargement is in the shape of a granophyre border, and in others of a solid vein of irregular outline surrounding a well-marked idiomorphic crystal.—In the course of an examination of a minette from Weiler, near Weiselburg, Alsace, Linck[6] found the porphyritic crystals of biotite to be surrounded

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.
[2] Neues Jahrb. f. Minn., 1888, i., p. 117.
[3] Amer. Naturalist, 1887, p. 850.
[4] Johns Hopkins Univ. Circulars, No. 65, April, 1888.
[5] American Naturalist, 1887, p. 372.
[6] Mitth. d. Comm. f. d. Geol. Landesuntere, von Elsass-Lothringen, 1887, i., p. 69.

by the dark zones so characteristic of the mineral in rocks of this class; when treated with hydrochloric acid, the dark color of the external rim was destroyed, leaving an isotropic substance, which the author supposes to be amorphous silica. He explains the origin of the zinc by supposing the biotite to have been acted upon by the remainder of the liquid magma, from which it had separated, and thus to have lost a portion of its alkaline and alkaline-earth constituents, which helped to form the feldspar, forming with small plates of biotite the entire groundmass of the rock. The iron left by this decomposition separated out as magnetite in the dark zinc.—In a late number of the *American Journal of Science* Mr. Kemp[1] describes a dyke of camptonite cutting the rocks in the Forest of Dean magnetite mine in Orange county, N. Y. The rock differs from the typical[2] camptonite in containing a larger proportion of feldspar and smaller crystals of hornblende. The feldspar is an oligoclase with the composition:—

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	K_2O	Na_2	Loss.
48.19	16.79	18.37	6.85	1.32	1.11	5.59	2.31

—While engaged in studying a peridotite from Little Deer Isle, in Maine, Mr. Merrill[3] noticed the enlargement of its augitic constituents by the growth around it of a secondary augite with the same optical orientation, but a different color.

Mineralogical News.—In a very interesting paper on the chemical constitution of the different colored *micas* occurring in a pegmatite at Schüttenhofen, Bohemia, Scharizer[4] records the analyses of several members of the mica group of minerals, and draws some general conclusions in regard to them. The pegmatite is surrounded on all sides by limestone. Its constituents are arranged in three zones, in the first of which *lepidomelane* and white and brown *muscovite* occur. In the second a yellowish white muscovite, and in the third *lithium micas*. Analyses of these are given as follows:—

	Lepidomelane.	Brown Mus.	Yell.-white Mus.	Lithium-mica.[5]
SiO_2	35.31	43.67	44.08	49.26
TiO_2	1.20			
SnO_2	.16			.06
Al_2O_3	22.62	36.69	36.83	25.27
Fe_2O_3	5.68	2.10	.48	
FeO	18.04	.55	.74	.84
MnO	1.19	tr	.25	.85
MgO	3.69			
CaO			1.99	

[1] Amer. Jour. Sci., April, 1888, p. 331.
[2] Ib., III, xvii, p. 147.
[3] Ib., June, 1888, p. 488.
[4] Zeits. f. Krystallographie, 1888, xiii., p. 449.
[5] Cf. Am. Jour. Sci., xxxii., p. 353.

K_2O	8.61		11.10	
$(K.Rb.Cs)_2O$		8.57		13.85
Na_2O	.62	1.95	.21	.35
Li_2O	.30	tr	.37	5.38
H_2O	1.21	4.35	4.98	1.76
Aq	2.30	1.15	1.17	
Fe	.60	.35	.19	5.68

In the discussion which closes the paper Scharizer concludes that all lepidolites are isomorphous mixtures of the pure muscovite molecule with the molecule $(HO.F)_6.\ R^1_8\ Al_6\ Si_{10}\ O_{30}$.—A suite of specimens representing the rarer copper minerals of the Mammoth Mine region in Utah, having come into the possession of Messrs. Hillebrand and Washington,[1] an investigation of their physical and chemical properties was undertaken to determine their true nature. Measurements of the interfacial angles of *olivenite* from the American Eagle mine yielded as the axial ratio for this mineral .9396 : 1 : .6726. It was impossible to determine whether the mineral is orthorhombic or not in consequence of the poor reflections from the $\infty P\bar{\infty}$ faces. Olivenite from the Mammoth Mine is well crystallized, with a tabular or prismatic habit. The planes most prominent on it are $\infty P\bar{\infty}$, ∞P, $P\breve{\infty}$, $\infty P\breve{\infty}$ and $P\bar{\infty}$. Its pleochroism is olive-green parallel to *c*, and brownish yellow parallel to *b*. On small hexagonal crystals of *chalcophyllite* the two new planes $-\frac{1}{3}R$ and $-\frac{1}{6}R$ were noticed. These crystals are tabular in habit, with OP largely developed, and are grouped into little rosettes. *Clinoclasite* occurs both in crystals and in globular and barrel-shaped forms, due to the grouping of crystals in a position varying slightly from parallelism. On the crystals, which are usually elongated in the direction of the *b* axis, the two new forms P and $\frac{1}{3}P$ were detected. Analyses indicate the correctness of the formula usually ascribed to this mineral, viz.: $Cu_3\ (AsO_4)_2 + 3Cu\ (OH)_2$. Two types of *brochantite* (hydrous sulphate of copper) were also examined. Crystals of the first type are dark green, and are prismatic in habit. Those of the second type are of a light green color, and have a curved double-wedge shape, produced by the occurrence of $3\ P\bar{12}$ and $\infty P\breve{\infty}$ faces. A mineral with the general appearance of *tyrolite* yielded Mr. Hillebrand:—

CuO	ZnO	CaO	MgO	As_2O_5	P_2O_5	H_2O	SO_3
46.38	tr	6.69	.04	26.22	tr	17.57	2.27,

a result indicating a composition corresponding to $5CuO.\ As_2O_5.\ 7\frac{1}{2}H_2O$, instead of to the generally accepted formula, $5CuO.\ As_2O_5.\ 9H_2O$. The mineral forming delicate tufts of silky needles of a light color, supposed by Mr. Pearce[1] to be a new mineral, has been found upon closer examination to have the composition of *Mixite* $(Cu_{20}\ Bi_2\ As_{10}\ H_{44}\ O_{70})$, but different physical properties. It is uni-

[1] Amer. Jour. Sci., xxxv., April, 1888.

axial or orthorhombic, and its specific gravity is 3.79.—According to Prof. Chester,[1] the *marcelite* from Cumberland, R. I., and the photicite and klipsteinite from Jackson county, N. C., are nothing more than mixtures of rhodonite and its decomposition products, a conclusion to which Prof. Bauer,[2] of Marburg, assents.—Native *platinum* and *cinnabar* are reported[4] as occurring in British Columbia. The former has been found in the bed of a branch of the north fork of Similkameen River. It is in the form of rounded grains and pellets. It has the composition:—

Pt	Pd	Rh	Ir	Cu	Fe	Os Ir	Gaugue.
72.07	.19	2.57	1.14	3.39	8.59	10.51	1.69

The rare minerals[4] *uranite*, *gummite* and *uraconite* have also been found in Canada, at the Villeneuve mica mine, Ottawa county, Province of Quebec.—*Xanthitane*, from Green river, Henderson county, N. C., is an alteration product of sphene. It is apparently a clay with the silica replaced by titanium. The air-dried substance loses 6.02 per cent. of water at 100°. The composition of the dried material is:—

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	CaO	P_2O_5	H_2O
1.76	61.54	17.59	4.46	.90	4.17	9.92

—Bement[5] mentions the occurrence of fine crystals of *wulfenite* at the Red Cloud mine in Arizona, and beautiful *azurite* and *malachite* at Bisbee, in the same State.—Knop[6] declares the olivine from the limestone of Schelinger, in the Kaiserstuhl, to be *forsterite*, with the composition:—

SiO_2	MgO	FeO	MuO	Al_2O_3
41.88	49.83	4.56	1.73	trace

CRYSTALLOGRAPHIC NEWS.—In a very interesting paper recently published, L. Wulff[7] shows that each of the three possible kinds of tetartohedrism probably occurs on crystals of the regular system. The forms derived by the three different kinds of selection can, however, not be distinguished from each other and from some of the hemihedral forms in the same system, except by a combination of morphological and physical observations. By these methods Wulff is lead to conclude that the bromate and chlorate of sodium crystallize in the gyroidal-tetrahedral division, and that the

[1] Neues Jahrb. f. Min., etc. 1888. I., p. 187.
[2] Ib., p. 214
[3] Ann. Rep. Geol. and Nat. Hist. Surv. of Canada in 1886. T. p. 5. Ib. p. 10.
[4] Eakins. Am. J. Science, May, 1888, p. 418.
[5] Zeits. f. Kryst., xiii., 1887, p. 46.
[6] Ib., xiii., 1887, p. 236.
[7] Zeits. f. Kryst., xiii., 1887, p. 273.

nitrates of barium, strontium and lead crystallize in the pentagonal-tetrahedral division of the regular system. Analogous results[1] follow from a discussion of the possible kinds of letartohedrism in the other systems.—Scharizer[2] describes honey-yellow to greenish *xenomite* crystals from a pegmatite vein near Schüttenhofen, Bohemia. The most prominent type is that produced by the combination of the prisms and pyramid with the ditetragonal pyramid, though ricinal planes obscure to some extent the tetragonal symmetry of the mineral. The axial relation is 1 : .62596. In a second type the prismatic faces are wanting.—Wine-yellow crystals of *barite* from the phenolite of Oberschaffhausen, in the Kaiserstuhl, have been examined by Beckenkamp.[3] Three types are recognized. The first is characterized the large development of the prismatic and basal planes, while the second type contains in addition the brachydomes. The third type contains the latter faces developed to the almost complete exclusion of the prismatic faces. The axial ratio of the crystals is .8151 : 1 : 1.3019. They are pleochroic in yellow and white tints.—Cathrein[4] has found in the *adularia* from Schwarzenstein, Zillerthal the prismatic faces $\infty \bar{P}\frac{9}{5}$, $\infty \bar{P}\frac{8}{5}$ and $\infty \bar{P}\frac{7}{5}$, the orthodomes $\frac{8}{7}\bar{P}\infty$ and $-280\bar{P}\infty$, and the orthopyramid $\frac{21}{20}\bar{P}9$, all of which are new to orthoclase.—Crystals of *chalcopyrite*[5] from Holzheim, in Nassau, are interesting in that they contain the scalenohedron modified only by the very small planes $\frac{P}{2}$ and $2P\infty$.

[1] Ib., xiii., 1888, p. 474.
[2] Ib., xiii., 1887, p. 15.
[3] Zeitschrift, f. Kryst., xiii., 1887, p. 25 and p. 386.
[4] Ib., xiii., 1887, p. 332.
[5] H. Mayer. Ib., xiii., 1887, p. 47.

BOTANY.[1]

The Genus Taphrina of Tulane.—This genus (*Exoascus* of Fuckel) of curiously simplified Ascomycetes, is an interesting one for the comparative anatomist, affording as it does such a remarkable instance of structural degradation through parasitism. By Winter (Krypt-Flora v. Deutschland, Oesterreich u. d. Schweiz. 1r Band, 2r Abth., pp. 2–11) the genus was made the principal one of the first order (Gymnoasceæ) of the class Ascomycetes. He divided the Gymnoasceæ into two families, viz.: (1) Exoasci and (2) Gymnoasci, the first including the genus under consideration (under Fuckel's name, Exoascus), and the second, the related genera, Endomyces, Eremascus, Gymnoascus and Ctenomyces.

The extreme simplicity of these plants, composed as they are of little more than single parasitic asci, marks to a great extent their relationship to the larger Ascomycetes. Parasitism has here brought about an almost complete atrophy of the plant body, as in the vine rapes (Rafflesiaceæ), among the parasitic Phanerogams the plant body is almost entirely suppressed, leaving only the large flower bud which grows directly from its hort.

The genus has been recently made the object of study by a Swedish student, C. J. Johanson of Upsala,[2] who has distinguished twenty-one Scandinavian species, as follows:—

Taphrina pruni Tul. (*Exoascus pruni* Fkl.).

T. bullata Tul. (*Exoascus bullatus* Fkl.; *Ascomyces bullatus* Berk.).

T. insititiæ Johans. (*Exoascus insititiæ* Sadebeck).

T. deformans Tul. (*Exoascus deformans* Fkl.; *Ascomyces deformans* Berk.).

T. nana Johans.

T. potentillæ Johans. (*Exoascus deformans* Fkl.; var. *potentillæ* Farl.

T. alnitorqua Tul. (*Ascomyces tosquinetii* Westd.).

T. betulina Rostrup (*Exoascus turgidus* Sadebeck).

T. alpina Johans.

T. borealis Johans.

T. aurea Fries (*Exoascus aureus* Sadebeck; *E. populi* Thüm.).

T. sadebeckii Johans. (*Exoascus flavus* Sadebeck).

T. betulæ Johans. (*Exoascus betulæ* Fkl.; *Ascomyces betulæ* Magnus).

T. rhizophora Johans.

[1] Edited by Prof. Chas. E. Bessey, Lincoln, Neb.
[2] Kong. Vetenskaps-Akademie. Band 13. Afd. III. No. 4.

T. cœrulescens Tul. (*Exoascus cœrulescens* Sadebeck; *Ascomyces cœrulescens* Demoz and Mont.).

T. carpini Johans. (*Exoascus carpini* Rostrup).

T. polyspora Johans. (*Exoascus polysporus* Sorokin?).

T. bacteriosperma Johans.

T. carnea Johans.

T. filicina Rostrup.

T. ulmi Johans. (*Exoascus ulmi* Fkl.).

In an article in the *Annals of Botany* for November, 1887, B. L. Robinson reviews the structure and history of Taphrina, and compiles an annotated catalogue of the North American species, so far as known. According to this article there are eight well-known species, with several others which are less perfectly known, as follows:—

Taphrina pruni Tul., on the fruit of *Prunus domestica* L., forming "the so-called 'plum pockets.'" The Taphrina on *Prunus maritima* Wang., *P. virginiana* L., and *P. serotina* Eber., is considered to be "probably identical."

T. deformans Tul., causing the "peach curl" of the leaves of the peach tree. A Taphrina, probably the same as this, has been found several times in Massachusetts deforming the leaves and branchlets of *Prunus serotina* Eber."

T. purpurascens Robinson (*Ascomyces deformans* Berk. var. *purpurescens* Ellis and Everhart). On leaves of *Rhus copallina* L., causing them to become dark purple in color, wrinkled, limp, and pendent.

T. potentillœ Johnson, on leaves of *Potentilla canadensis* L.

T. flava Farlow, on leaves of *Betula alba*, var. *populifolia* Spach, and also on *Betula papyracea* Ait. "This species must be carefully distinguished from the more recent and very different *Exoascus flavus* of Sadebeck."

T. alnitorqua Tul., "on bracts of the fertile catkins of the alder."

T. aurea Fries. "The only form of this species yet found in America, attacks the fertile catkins of poplar trees (*Populus grandidentata* Michx.).

T. cœrulescens Tul., on the leaves of various species of oaks, producing grayish or bluish spots.—*Charles E. Bessey.*

THE TWENTIETH AND TWENTY-FIRST CENTURIES OF N. A. FUNGI.—In March of the present year these numbers were received by subscribers from the hands of the editors, J. B. Ellis and R. M. Everhart. No change has been made in the style of the work, whose uniform excellence reflects great credit on American botany.

Century XX. contains eight species of Agaricus, three of Boletus, four of Cantharellus, five of Hygrophorus, four of Lenzites,

two of Geaster (the new species described by Morgan in Nov. AM. NAT.), and two of Lycoperdon. The remaining species are for the most part parasitic microfungi.

Century XXI. contains nine species of Agaricus, six of Clavaria, fourteen of Peziza, besides single species of many genera of the larger fungi. The microfungi are also represented by many genera. At the close of the volume, Nos. 2085 to 2100 inclusive are species of Myxomycetes, determined by Dr. Rex and Harold Wingate. The species are (2085) *Physarum cinereum* Batsch, (2086) *P. contextum* Pers., (2087) *Tilmadoche columbina* Berk., (2088) *Stemonites morgani* Pk., (2089) *Didymium eximium* Pk., (2090) *D. fuckelianum* Rfski., (2091) *D. clavus* A. and S., (2092) *Siphoptychium casparyi* Rfski., (2093) *Chondrioderma testaceum* Schrod., (2094) *Comatriche gracilis* Wingate, (2095) *Cribraria intricata* Schrod., (2096) *Tubulina cylindrica* Bull., (2097) *Trichia fragilis* Low., forma *simplex*; (2098) *T. fragilis* Low, forma *botrytis*; (2099) *T. varia* Pers., (2100) *T. scabra* Rfski.

Mr. W. C. Stevenson, Jr., of Philadelphia, has agai nearned the thanks of botanists by making an Index of Habitats for Centuries XI. to XX. of the North American Fungi.—*Charles E. Bessey.*

ALLEN'S CHARACEÆ OF AMERICA.[1]—As its title indicates, this is the first part of what it is hoped will eventually be a complete monograph of the Characeæ of America. In his introduction the author says that "the demand for information concerning these plants is so pressing that it is thought but to issue the first part ot the work now, to be followed in a year or two by the second part, which will contain descriptions of the species now known to inhabit American waters."

The part before us contains (1) an Introduction, mainly devoted to collection, preservation, habitat, etc., (2) a chapter principally consisting of structural details, with a brief historical statement. In this, the term *sporophydium* is introduced for the spore-fruit or sporocarp. We prefer the term *sporocarp,* and regret that our author did not adopt it rather than the other. The term proposed possesses, of course, the advantage of being non-committal as to homologies, but to the present writer it would appear entirely safe to adopt so fitting a term as sporocarp, in place of the vague one of sporophydium (*spora* and *phudion,* diminutive of *phu,* a growth; the term thus signifies a spore growthlet, *i.e.,* a little spore-growth). Following this is (3) a chapter entitled Classification and Synopsis.

[1] *The Characeæ of America.* Part I. Containing the Introduction, Morphology, and Classification. By Timothy Field Allen, M.D., LL.D., Fellow of the New York Academy of Sciences, Corresponding Member of the Buffalo Academy of Natural Sciences, of the Portland Society of Natural History, etc. With fifty-five illustrations. New York, No. 10 East Thirty-sixth street. 1888. 8vo. 64 pp.

This final chapter includes the technical characters of the families and genera represented in America, with synoptical descriptions of the species. The system adopted may be summarily shown as follows:—

CHARACEÆ Richard.

Family I. NITELLÆ u. Leonhardi.

Genus 1. *Nitella* Ag., containing 79 species.

Genus 2. *Tolypella* A. Braun, with 13 species.

Family II. CHARÆ u. Leonhardi.

Genus 3. *Lamprothamnus* A. Braun, containing a single species, presenting three varieties.

Genus 4. *Lychnothamnus* Rupr. u. Leonhardi, with 3 species.

Genus 5. *Chara* Vaill u. Leonhardi, with 62 species, besides many varieties.

The order is thus shown to contain 158 species, of which 58 are given as North American, there being 30 species of Nitella, 8 of Tolypella, and 20 of Chara so recorded.—*Charles E. Bessey.*

ZOOLOGY.

DIRECT NUCLEAR DIVISION IN EUPLOTES.—Dr. K. Mobius describes (*Stzb. Gesellsch. Naturf. Freund*, Berlin, 1887) direct nuclear division in the fission of *Euplotes harpa*. The nucleus elongates transversely, becomes thinner in the middle, and at length divides, the two halves remaining connected by but a thread at the time when the oral cilia of the second individual are formed. Killing with osmic acid and staining with saffranin showed that the chromatin was mostly arranged in thread-like rows of granules and that karyokinetic figures were never formed.

THE FOOT IN PROSOBRANCHIATE MOLLUSCS.—Mr. H. L. Osborn (*Proc. Am. Assoc. Adv. Sci.*, XXXVI.) gives in abstract the results of his researches on the morphology of the foot in the Gasteropods. In Fasciolaria and Fulgur it arises as a paired (not median) elevation of the ectoderm behind the velum and the blastopore. These later coalesce. The conclusions are that this organ must be regarded as ontogenetically, and, possibly, phylogenetically, belonging to the series of paired locomotor organs, like those of annelids and arthropods. To this view, however, the author points out certain difficulties.

THE ELECTRIC LIGHT IN MARINE COLLECTING.—Professor W. A. Herdman communicates to *Nature* an account of experiments made with the electric light in marine collecting, from which we make the following extracts: A sixty-candle power Edison-Swan submarine light was arranged in the mouth of a tow-net, and the whole lowered to a depth of three fathoms and allowed to remain there for half an hour. Another similar net, but without illumination, was lowered on the opposite side of the ship to the same depth and for the same length of time. When hauled to the surface the dark net contained practically nothing, while the other held an abundant gathering, consisting chiefly of Crustacea. Another test was made, both nets being lowered to the bottom (six fathoms), and with similar results. It was noted that the Amphipods taken with the light in the deep net appeared to be mostly red-eyed species. If on detailed examination this is confirmed, it may indicate an interesting relation between the color of the eyes and sensitiveness to the electric light.

THE FAUNA OF THE SUEZ CANAL.—Dr. E. von Martens exhibited at a meeting of the Berlin Gesellschaft Naturforschender Freunde (*Stzber.* 1887) a collection of shells made in the Suez Canal, and made some remarks upon the origin of the fauna of the Canal. Collating all known observations, he found that of twenty-seven species of molluscs found in the Canal, nine came from the Mediterranean and eighteen from the Red Sea. An examination of the fishes showed a similar condition. Of sixteen species reported from the Canal, six were from the Mediterranean and ten from the Red Sea side. The distribution of the species in the different parts of the Canal is shown by tables; and a glance at these clearly indicates that the admixture of faunæ is far from complete.

BRAIN OF CERATODUS.—In a paper (*Proc. Roy. Soc'y.*, XLIII.) Mr. Alfred Sanders concludes that the brain of Ceradotus presents an embryonic condition in three respects, viz.: first, in the extreme size of the ventricles and in the tenuity of the substance of their walls; second, in the alternating origins of the dorsal and ventral roots; third, in the fact that the origins of the dorsal roots are close to the central line. Compared to Protopterus, it differs in the shape and the imperfection of the cerebral lobes, and in the fact of its having a well-developed rhinencephalon; but it agrees in the narrowness of the thalamencephalon and mesencephalon, and in the breadth of the medulla oblongata, as also in the rudimentary character of the cerebellum. Ceratodus agrees also with the ganoids in the comparative narrowness of the mesencephalon and in the proportions of the cerebellum. With the Plagiostomes it agrees in the structure of the optic lobes, both orders presenting a large ganglion

of large cells in the dorsal part. With the Teleostei it agrees in the multi-axial fibres which, a short distance anterior to its termination, resemble Mauthner's fibres, also in the position and fact of their decussation. With Petromyzon it agrees in the structure of the tela choroidea, which covers the fourth ventricle.

Deep Sea Fishes.—Not less than 3800 specimens of deep-sea fishes were dredged in the last voyage of the Talisman. At the dredging No. CX., as many as 931 were captured, of which 780 were *Hymenocephalus italicus* Giglioli.

The truly deep-sea fishes, says M. L. Vaillant, belong to the Elasmobranchiata and to the Teleostei, since the Marsipobranchs do not descend beyond five or six hundred metres. The deep-sea Elasmobranchs yet known are few, and these, singularly enough, are all sharks. That they are very abundant at certain points is proved by the special fishery of Setubal (off the coast of Portugal), and by some individuals taken by the Talisman on the Soudan coast, at depths of from 600 to 1400 metres. Below 500 metres the Acanthopteri become scarce, and such as occur belong for the most part to abnormal types; such as *Melanocetus johnsonii* and the species of Notacanthus. Apodal fishes seem to be more abundant, but the great bulk of the abyssal fishes belong to the Abdominales and to the Anacanthini.

The family Alepocephalidæ, which for a long time contained but a single species, has now six genera, two of them formed to contain species collected by the Talisman, viz.: *Anomalopterus pinguis* and *Leptoderma macrops*. Other new species of this family gathered by the Talisman are: *Alepocephalus macropterus*, *Bathytroctes attritus*, *B. homopterus*, *B. melanocephalus*, and *Xenodermichthys socialis*. These forms, added to those described by Dr. Gunther and others, raise the known species of this family to fifteen. Most of these fishes have the dorsal and anal fins thrown back upon the caudal peduncle, and seem adapted for easy and rapid locomotion.

Among the Anacanthini of the abyssal fauna the Pleuronectidæ are not present. *Pleuronoctes megastoma* was dredged by the Talisman in 560 metres, and this is the greatest depth at which any fish of this family has yet been found. Among the Lycodidæ, *Lycodophis albus* has been found at more than 4000 metres. The Gadidæ themselves have not been dredged at great depths, except the new genus Scopelogadus, which has been taken at 3655 metres.

The absence of Gadidæ from deep-sea dredgings may possibly be accounted for by the superiority of their swimming powers, while, says M. L. Vaillant, the abundance of the Ophidiidæ and Macruridæ may be correlated with the weakness of their caudal peduncle, and the almost complete absence of the caudal fin. The Talisman

dredged the Macruroid *Coryphænoides gigas* at a depth of 4255 metres, and *Alexiterion parfaiti*, nov. gen. and sp. of Ophidiidæ at 5005 m. Among new Ophidiidæ collected by the Talisman are two species of Porogadus and five of Bathyonus. Many of these were taken at 3200 metres.

The abyssal fish fauna seems to be in great part homogeneous. Bathysaurus, Halosaurus, Bathypterois, Macrurus, Coryphænoides, and many other genera are found both in the Atlantic and in the Pacific, and many species seem to have an extensive distribution. Thus *Dicrolene introniger* occurs near the North American coasts and on those of the Soudan; *Macrurus holotrachys* Gunt., discovered at the mouth of the La Plata, has been dredged on the Maroccan coast; *Stomias boa* of the Mediterranean has been taken in the Arctic Ocean, in the Atlantic, and in the Pacific; and the Talisman captured at the Azores, off the Soudan, and at the Cape Verde Islands, a Macrurid which seems to be *Macrurus japonicus* Schleg.

Vacuities in the Skulls of Mammals.—Dr. D. D. Slade presents (*Bulletin Mus. Comp. Zoology*, XIII., 8) a comparative study of certain vacuities found in the macerated mammalian skull. These spaces are due to an arrest of osseous development, and are secondary to the original growth of the bone, but are not to be confounded with air-cells like those of the elephant or as products of absorption. Two types are distinguished: (1) Those that are dependent upon arrested ossification in the body of a bone or at a point where several bones would otherwise come in contact, but neither of which has any special adaption to function; (2) Those that are due to enlarged openings, the result of arrested ossification, which have adaption to special function, and retain this, notwithstanding the modifications which they may have undergone. Examples are described in all of the orders of Mammalia, two plates illustrating the paper.

The Teeth of Sheep.—Miss Florence Mayo has recently investigated (*Bulletin Mus. Comp. Zool.*, xiii.) the question as to whether at any stage of development there occur germs of the superior canines and incisors in the sheep, a question upon which there were conflicting opinions. She finds that at a certain stage in the development of the embryo sheep the dental lamina exists throughout the incisor and canine regions and that in the latter an enamel organ is formed but nowhere is there a dentine germ. No enamel is ever formed and the organ soon disappears. From the standpoint of phylogeny Miss Mayo thinks that the disappearance of the teeth has been a progressive one, beginning with the middle incisors and gradually extending back. This has already been shown by palæontology.

Local Variations in the Colors of a few Nebraska Flying Squirrels.—Coues and Allen, pp. 656–661, *Monographs of North America Rodentia*, published in 1877, being Vol. XI. of Hayden's Report of the United States Geological Survey of the Territories, state that:

"The American Flying Squirrel, (*Sciuropterus volucella*), presents a range of geographical variation in size quite unparalleled in other members of the *Sciuridœ*, and only equaled in some species of the *Canidœ*, and possibly in *Cervus virginianus*. On the other hand the coloration is remarkably constant, almost exceptionally so. * * * Specimens from the same locality sometimes differ in the color of the dorsal surface as much as do the most diverse examples from widely separated localities."

The local variations in color are well illustrated by five specimens before the writer, viz:—

No.	When collected.	Collector.	Length of body.	Length of tail.	Age.
1	Oct. 26, '85	Miss S. Thom	7.25	5.35	Adult
2	Winter (?), '87	W.B. Harmon	7.00	5.00	Adult
3	Nov. 10, '85	E. E. Good	6.05	5.00	Ad't (?)
4	Nov., '85	J.W.Crabtree	5.20	4.25	Young
5	Winter (?), '87	W.B. Harmon	7.00	5.00	Adult

In numbers one and four the dorsal surface was a dusky brown tinged with fulvous; while the dorsal surface of numbers two and three was nearer a dull yellowish, with a very slight taint of fulvous. The color of the furred membrane of numbers one, two, three and four is of a decidedly blackish cast, deepening near the edges; each specimen being of about the same shade. In each the ventral surface is whitewashed with yellow or fulvous, there being but a slight shade in the washings. Pelage on the ventral surface white to the base.

The upper portion of the tail of numbers one, two, three and four was a dusky yellow color tinged with black, the tail of number two possessing more black than the rest, it being of a darker cast than the dorsal surface of the body. In the case of numbers one and four the dorsal surface of the body possessed more black than the upper surface of the tail, while number three approximated number two. The upper surface of the tail of number two was perceptibly blacker near the distal end. Excepting very slight shades of yellow the under surfaces of the tails of numbers one, two, three and four, were alike; being of a slightly dusky light yellow. Immediately beneath and longitudinally with, the vertebrae of the tails of the four specimens mentioned, was a faint white line. In all the lower surface of the tail is darker and more fulvous than the lower surface of the body; also lighter and much

more yellow than the dorsal surface of the body. In numbers one, two, three and four the eye is encircled by a narrow dusky ring; also in front of this organ is a dusky spot, while the white spot ordinarily found at the base of the ear was almost, if not completely, obsolete.

Number five was a very unusual specimen, both in color and in the arrangement of the color. Mr. W. B. Harmon, who collected this specimen, states that four other squirrels were found in the nest with this one, number two being one. The other two appeared to be similar to number two in color. Besides the measurements already given the description of number five is as follows:

Dorsal surface very light fulvous brown; the color being very regular over the dorsal surface. Below light cream white faintly tinged around the edges with light fulvous brown. Tail above of the same color and shade as the dorsal surface of the body, with edges a shade lighter. The tail below was a shade lighter still and marked by a faint white streak immediately below and longitudinally with the tail vertebræ, and increasing in width and distinctness near the distal end. Pelage on the ventral surface white to the base. The white spot at the base of the ear was quite distinguishable, being about the size of the ear. The narrow dusky ring around and the dusky spot in front of the eye, ordinarily, were obsolete. The pelage on the upper surface of the body was of the same color to the base. The only black or dark hairs visible were the mustaches, which were black. The hair has the appearance of being in a healthy condition, and the specimen is rather above the average size. This specimen is undoubtedly an extreme case of color variation.

Habitat, near Nebraska City, Nebraska, on the Missouri river, in latitude about 40° 30′.

It might be well to notice that the average measurements given in this article are about the same given by Coues and Allen for *S. volucella* var. *hudsonius*, which is stated to exist "mostly north of the parallel of 49°; average measurements of var. *volucella*, the southern variety, being much less.—*W. Edgar Taylor, Nebraska State Normal School, Peru, Nebraska.*

Zoological News.—Sponges.—J. Arthur Thompson describes (*Trans. Roy. Soc., Edin.*, xxxiii.) the structure of the sponge *Suberites somuncula*. The study was rendered difficult from the presence of large numbers of silicious spicules. The ciliated chambers are small, and are in connection with the canal system, the afferent and efferent canals lying side by side. The canal system is of what is known as the fourth degree of complexity. In the same paper are noticed peculiar club-shaped prominences on the surface of Spongelia the function of which is problematical. These knobs

have a well-developed ectoderm, the centre being occupied by a compact and intricate network of fine filaments, the meshes of which were occupied by cells of varied size. Similar structures, it may be noted, occur in several American sponges.

Cœlenterata.—G. H. Fowler describes (*Proc. Zool. Soc.*, 1888), a new Pennatula (*P. bellissima*) from the Bahamas. In its systematic position it stands nearest *P. naresii.*

Prof. A. M. Marshall monographs the Pennatulids collected by the "Porcupine" in the *Trans Roy. Soc., Edin.*, xxxiii. Sixteen species are enumerated.

Molluscs.—R. S. Call describes as new (*Proc. Nat. Mus.*, 1887) *Unio ozarkensis* and *U. breviculus* from Missouri.

Echinodermata.—Mr. A. B. Griffiths has proved that the nature of the secretion of the pancreatic follicles of *Uraster rubens* is similar to that of the pancreas of the Vertebrata. The secretion was submitted to a careful chemical and microscopical investigation (*Edin. Roy. Soc. Proc.*, No. 125, p. 120). With a quantity of the secretion uric acid crystals were extracted by methods previously described by the same writer. The pancreatic follicles are borne upon five pairs of tubules, each pair proceeding from one of five radial ducts given off by the pentagonal "pyloric sac" situated on the aboral side of the stomach of the star-fish. The tests showed the entire absence of urea in the secretion, and no guanin or calcium phosphate could be detected.

Researches into the nature of the secretion of the salivary glands of *Sepia officinalis* and *Patella vulgata*, recently carried out by Mr. A. B. Griffiths, prove that these organs have the same physiological function as the salivary glands of the Vertebrata. The cuttle-fish has two pairs of these glands, the secretion of the anterior smaller pair passing directly into the buccal cavity, while that of the posterior larger pair is poured into the œsophagus. The two salivary glands of Patella are situated in front of the pharynx and give off four ducts.

Crustacea.—Richard Rathbun (*Proc. Nat. Mus.*, 1887) adds to our knowledge of American parasitic Copepoda by describing several new species belonging to the genera Trebius, Perrisophus and Lernthropus, from the collection of the U. S. Fish Commission.

According to Mr. A. B. Griffiths, the secretion of the so-called liver of *Carcinas mœnas*, when freshly killed, gives an acid reaction, and its functions are more like those of the pancreas of the Vertebrata than like those of a true liver. The organ consists of two

large glands on each side of the stomach, of a yellow color, and composed of numerous cœcal tubes arranged in tufts.

FISHES.—Dr. H. H. Giglioli, of the Royal Museum of Florence, records (*Nature*, XXXVIII., 103) the receipt of the sixth known specimen of the rare *Lepidosiren paradoxa*, which for many years was only represented by Natterer's original specimens. The present individual was taken at Antaz, near the Madeira River, in September, 1887, and when received was in a state of incipient decomposition. Mr. G. B. Howes communicates a note on the same subject (*l.c.*, p. 126), calling attention to the specimen recorded by Bibron and Milne-Edwards in 1840.

Professor C. T. Lutken has recently (*Vidensk. Selsk. Skr. Kjob.*, IV.) described the skeleton and some other parts of the deep-sea toad-fish Himantolophus. Comparisons are made with Ceratias.

According to Prof. D. S. Jordan and B. W. Evermann, there are about 150 species of fishes known in the waters of Indiana, and about fifty of these may be regarded as food-fishes. Of the remaining kinds, some ten are large enough for food, but for one reason or another are not used. The flesh of the paddle-fish and shovel-nosed sturgeon is poor and tough, that of the gar-pikes is not eatable, while the hickory shad and skip-jack are valueless on account of their dry thin flesh, full of small bones.

The cisco of the deep lakes of Northern Indiana and Wisconsin, formerly thought by Prof. Jordan to be distinct from the leak herring, and named by him *Argyrosomus sisco*, is now held by, the same authority to be only a local variety of *Coregonus artedi* modified by residence in the smaller lakes.

Prof. W. N. Parker lately read before the Roy. Zool. Soc. a communication on the poison-glands of the genus Trachinus. This paper showed the existence of glands, composed of large granular nucleated cells, continuous with those of the epidermis, in connection with the grooved dorsal and opercular spines of the two British species of the genus.

Dr. A. Gunther (*Ann. and Mag. Nat. Hist.*, June, 1888) describes nine new species of fishes from the Yangtsze-kiang, collected at or near Ichang. One of these, *Eleotris xanthi*, belongs to the spine-finned section, the others are Cyprinidæ or Cobitidina.

M. R. Storms has, in an article in the *Annals and Magazine of Nat. Hist.* for July last, attempted to solve the questions pertaining to the structure and morphology of the disk of the remora. That the disk is a modified spinous dorsal, and not of dermal origin, he believes to be proved: (1), by its position; (2), by the slight transformation of the interneural spines; (3), by the presence of the changed, yet recognizable elements of a normal spinous dorsal fin. A typical segment of the spinous dorsal of Scomber has three

elements: (1), an interneural spine; (2), an intercalary bone (or baseost) which has the shape of two wings; and (3), a spinous ray. A division of the disk of Echeneis has also three elements; the lower extremities of the interneutrals point backwards instead of forwards; the intercalary bone is formed of wing-like plates, and the spinous ray is represented by a pair of pectinated lamellæ joined in the median line and occupying the whole surface of the disk. The upper expanded portions of the interneural spines each carry a pair of lamellæ. The wing-like plates of the intercalary bone are connected by a narrow portion which expands in the middle and rests partly on the interneurals, and the wing-like parts of the consecutive intercalary bones overlap one another like the tiles of a house. The pectinated lamellæ are discovered by M. Storms as transversely enlarged spines, and he believes that the bases of the spines alone have formed the lamellæ, and that the spine proper was gradually reduced until it has nearly disappeared. The rows of small teeth which cover the posterior margins of the lamellæ are by M. Storms thought to be of dermal origin. That they are not formed by outgrowth of the bone is proved by the facility with which they fall off by prolonged maceration. The fossil *Echeneis glaronensis*, the disk of which extends only on to the posterior part of the head, instead of covering its whole surface, seems to support our author's supposition that the disk was originally formed on the dorsal region, and has migrated gradually to its present position.

Reptiles and Batrachia.—Dr. O. P. Hay's list of Amphibia and Reptilia at present known to occur in the State of Indiana includes seventy-seven species, twenty-seven of which are Batrachia.

Dr. A. Günther (*Ann. and Mag. Nat. Hist.*, May, 1888) describes seventeen new species of snakes from tropical Africa, including four of Ahaetulla, five of Boödon, and one each of Causus, Elapsoidea, Simocephalus, Psammophis, Uriechis, Calamelaps, and Elapomorphus, also *Rhinocalamus dimidiatus*, new genus and sp.

Following the above paper Dr. Günther contributes a list of the snakes known from the lake-districts of Central Africa, and shows what is known of their distribution on the east and west coast. The difficulties attending the carriage of natural history specimens in Central Africa is so great, that it is only within the last few years that small collections of snakes have reached Europe. The list contains forty-six distinct forms obtained at Lado, Monbuttee, and Semmio, on the great Central African lakes southward to Lake Nyassa, at the foot of Kilimandjaro, in the Mpwapwa Mountains, and on the highlands of Ugogo. Of these, twenty-two have been found on the West coast, and twenty-five either in the Mozambique or Zanzibar districts of the East coast.

G. A. Boulenger (*Ann. and Mag. Nat. Hist.*, May, 1888) gives the distinguishing characters of the families Pelomedusidæ and Chelydidæ, and states that the former family (though from its structure it must be included in the Pleurodera) differs from the rest of that group in having the neck completely retractile within the shell.

Dr. Paul Sarasin describes the lateral organs of the larva of the Ceylonese cœcilian as related to auditory organs of the invertebrate type.

According to *Nature*, a communication from Mr. George A. Treadwell was read at the meeting of the Zoological Society of London, May 15, containing an account of a fatal case of poisoning from the bite of the Gila monster (*Heloderma suspectum*).

Among a small collection of reptiles and batrachians made at Iguarasse-Pernambuco, Brazil, Mr. C. A. Boulenger reports the occurrence of a new species of Sphærodactylus, two of Hylodes, and one of Nototrema (the marsupial tree-frog). The other known species of the last-named genus are restricted to the Andes, from Central America to Peru.

The same naturalist also describes *Achalinus rufescens*, and *Calamohydrus* (n. g.) *andersonii*, two new species of snakes from Hong-Kong. A specimen of the rare sea-snake *Hydrophis viperina*, Schmidt (*Disteira præscutata* D. and B.) reveals, according to the same naturalist, a new type of dentition, since, instead of a pair of grooved fangs, followed after an interval by a series of smaller solid teeth, as is normal among the Hydrophidæ, it has a series of four equidistant, sub-equal, grooved fangs. *Ogmodon vitianus* Peters, is the only snake previously known to possess a series of grooved fangs.

G. A. Boulenger (*P. Z. S.*, Feb. 7, 1888) describes two new forms of Hoplocephalus from the Solomon Islands, and gives a list of the Reptiles and Batrachia of the group, comprising a crocodile, seventeen lizards, ten ophidians, and thirteen batrachians.

Birds.—Dr. Emin Pasha has recently forwarded to the London Natural History Museum, two collections of birds, the first, comprising 114 forms, from the Wadelai district, between 2° and 5° N. Lat., and 31° and 33° E. Long., while the other, consisting of forty-three species, is from the Tingasi district, westward of 31° E. Long. In the latter collection there is not a single East-African form, while in the former thirty-three forms belonging to the fauna of E. and N. E. Africa occur. It is thus evident that on the western water-shed of the lake-system of Equatorial Africa the Abyssinian fauna disappears and is replaced by the purely tropical features of the West-African river-system. Mr. Thomas attributes the abruptness of the change of fauna, exhibited both by mammals

and birds, to the sudden ending of the great West-African forest. Five previous papers, by Drs. von Pelzeln and Hartlaub, have described former ornithological collections sent to Europe by Emin Pasha, so that it is not to be wondered at that this, the first consignment received at London, contains only four new species.

MAMMALS.—In three papers (*Proc. Amer. Philos. Soc'y*, XXV.) Professor T. B. Stowell describes the glosso-pharyngeal, accessory, and hypoglossal nerves in the domestic cat. Three plates of diagrams illustrate the accounts.

At the meeting of the Royal Society of Edinburgh, May 7, 1888, Dr. Alexander Bruce described a case of absence of the corpus callosum in the human brain.

The skeleton of a second specimen of Swedenborg's whale (*Eubalæna swedenborgii*) has been discovered in Norway. It is said that the original specimen was discovered in the early part of the last century in Gothland, and that the bones were regarded as those of a giant, but that Swedenborg discovered their true nature.

Embryologists will find an account of the ductus endolymphaticus of the ear of the cat, by N. Rüdinger, in the *Sitzungsberichte* of the Munich Academy of Science for 1887. It is illustrated by three plates.

Dr. A. Nehring criticises (*Stz. Gesell. Naturf. Freunde*, Berlin, 1887) Gray's genera of the Fish-Otters. Lutronectes is based on two immature specimens of *Lutra vulgaris* from Japan. The genus Lontra of Gray, characterized by the hairiness of the muzzle, is untenable, because founded on individual variations. Nehring regards *Lontra braziliensis, Lutra enhydris, L. macrodus, L. solitaria, L. paranensis,* and *L. platensis* as nothing but local variations of one broad-fronted South American species. *Pteronura sandbachii* of Gray is regarded by Hensel as identical with *Lutra braziliensis* of F. Cuvier. Nehring also states (*l.c.*, p. 66), contrary to Gray and Wallace, that *Canis hodophylax* of Japan is not near to or identical with *C. rutilans* of Sumatra, but rather is to be associated with *C. pallipes* of India.

Mr. A. E. Pratt has obtained an example of the porpoise of the Yangtsze-kiang, which proves to be identical with, or closely allied to, *Delphinus melas* Schlegel.

T. Southwell, F. S. Z., after bringing together all accessible data upon the subject, comes to the conclusion that the European otter breeds in autumn and winter, but more often in the winter.

The collection of mammals recently received by the Natural History Museum of London from Dr. Emin Pasha includes 115 specimens of thirty-nine species. Every specimen is labelled with date, sex, and exact locality, in his own handwriting. Among them

is a chimpanzee, a *Colobus guereza*, two examples of *Galago demidoffi*, the flying squirrel *Anomalurus pusillus* n. sp., and a new coney *Dendrohyrax emini* Thomas. Fourteen of these species have not before been recorded outside of the West-African region, and Emin Pasha has therefore extended their known range a thousand or twelve hundred miles.

ENTOMOLOGY.[1]

A New Entomological Journal.—The first number of an entomological journal bearing the title *Insect Life* has just been sent out from the Division of Entomology of the United States Department of Agriculture. This journal is "devoted to the economy and life-habits of insects,—especially in their relations to agriculture,—and is edited by the entomologist and his assistants, with the sanction of the Commissioner of Agriculture." We are glad to welcome this periodical, for we believe it will be an exceedingly useful one. As the writer knows from personal experience, a vast amount of interesting matter accumulates in the office of the entomologist, and is buried there simply because the individual items do not seem of sufficient importance to be published in the formal reports of the department. It often happens, also, that results of considerable scientific interest are obtained, the practicable application of which cannot be seen at the time. Naturally, a government entomologist hesitates to publish such results in a report intended primarily for agriculturists. The pages of *Insect Life* will form an appropriate receptacle for all data of this kind. It will, also, enable the entomologist to publish promptly matter of ephemeral interest which would lose its value if kept for the annual report.

The present number contains several articles of considerable interest in addition to a large number of minor notes. We have only a single criticism to offer upon *Insect Life* as represented by the initial number. We regret to see in it an article of the nature of the one entitled *New Species of Oncocnemis.* This article consists of the technical description of five species of moths. In four

[1] This department is edited by Professor J. H. Comstock, Cornell University, Ithaca, N. Y., to whom communications, books for notice, etc., should be sent.

cases the description is based upon a single specimen; in the fifth upon but three. The species are from Utah, Colorado, and Nevada county, California. Although the descriptions appear to be very carefully written, and doubtless are excellent ones if it is possible to prepare good descriptions of species from unique examples, still, what is the occasion for publishing these descriptions here? Is it not about time that the serious workers in entomology should abandon the practice of publishing isolated descriptions except where there is a necessity for the description; as, for examples, in articles describing the life-habits of the species in question? We can see the reason for the description of *Lestophomus iceryea*, a parasite of cottony cushion scale which has been artificially introduced into California from Australia.

In form *Insect Life* has the appearance of the bulletins which have been sent out by the Division of Entomology, the size of the page and the type being the same. It is to be published on an average once a month, but will not have the regularity of a regular monthly.

Prevention of Curculio Injury to Cherries by Arsenical Poisons.—During the last two years we have heard it repeatedly asserted by fruit growers that curculio injury can be largely prevented by spraying the trees with Paris green or London purple. At first we were incredulous; but the statement has been made so positively that we have said in reply to inquiries that it might be so but that we could not say in what way the poison acted, as the eggs of the curculio are laid beneath the surface of the fruit and out of the way of anything which might be sprayed upon the tree. We are glad to see that Mr. Clarence M. Weed has begun his work as Entomologist to the Ohio Agriculture Experiment Station by conducting careful experiments on this subject. The results are very striking. They seem to show so far as the results of a single season's work with a single variety of cherries can be relied upon: "That three-fourths of the cherries liable to injury by the plum Curculio can be saved by two or three applications of London purple in a water spray(in the proportion of one ounce to five gallons of water) made soon after the blossoms fall."

Two quarts of cherries from each of the lots experimented on were chemically examined at the time of ripening by Professor H. A. Weber and showed no trace of arsenic.

No explanation is made by Mr. Weed as to the way in which the poison acts. Whether the adult beetles are destroyed before they lay their eggs or whether the poison reaches the young larvæ.

REPORT OF THE U. S. ENTOMOLOGIST.—The annual report of the U. S. Agricultural Department has just come to hand. The report of the Entomologist, although containing less original material than some of the preceding ones, is a valuable one to agriculturists. The principal articles are one upon the Chinch-bug and one upon the Codlin-moth. These were prepared by Mr. Howard, and consist in each case of a résumé of the natural history of the insect and of the more important remedial measures. Although these articles contain little that is new, they will be very useful to agriculturists, as they render accessible information not easily obtained outside of an entomological library. In addition to these two articles the report consists of reports of special agents. The most striking of these is the one by Mr. D. W. Coquillett on *The Gas Treatment for Scale Insects.* One of the principal discoveries made by Mr. Coquillett is that hydrocyanic acid gas when passed through sulphuric acid is rendered harmless to the foliage of trees confined in it. This will greatly lessen the cost and labor of treating trees with this gas. The report is illustrated with figures of portable tents which are used for enclosing the trees while they are being treated.

ANTS AND APHIDS.—In the report of Mr. F. M. Webster[1] as special agent of the Department of Agriculture, we find account of some experiments upon the corn plant-louse (*Rhopalosiphum maidis*). After narrating several experiments clearly showing that the ants collect the plant-lice and carry them to the roots of the corn, Mr. Weber makes the following remarkable statement: "These observations led me to conclude . . . . Also that ants, of which three species attend these plant-lice, viz., *Lasius flabius*, *Formica schonfussii*, *F. fusca*, are not in the least responsible for their distribution over the fields. Although the protection which they offer them greatly increases their number and the amount of injury done in the corn-fields."

We do not think that the conclusions of Professor Forbes[2] can be set aside in this way. We can think of no more interesting subject for study than the working out of the relations which exist between these two kind of insects. Certainly aphids must receive more important results from the development of the highly specialized nectar-secreting apparatus than has been dreamed of till recently.

[1] Report of the Commissioner of Agriculture, 1887, p. 149.
[2] American Naturalist, Vol. xxi., pp. 382–579.

EMBRYOLOGY.[1]

Observations on the Development of Cephalopods.[2]—In this memoir Mr. S. Watase deals very fully with the origin of the cells which give rise to the yolk membrane. With the exception of Lankester, all authorities agree in describing the "yolk membrane" as originating from the segmentation of the original germinal disk. As to the origin of the digestive tract, Kölliker and Bruce describe the digestive tract as continuous with the "yolk membrane." Balfour and Lankester derive the "mesenteron" from the lower layer of the mesoderm; Metschinikoff derives the major part of it from the ectoderm, while Ussow traces the whole digestive tract to the ectodermic involutions.

Mr. Watase's conclusions are as follows in regard to these points: (1) The "yolk membrane" is derived from the original germ disk; (2) it makes its appearance underneath the marginal zone of the germ disk, near to the junction of the intermediate zone; (3) the cells of the "yolk membrane" are irregular in outline, fusiform in cross-section, amœboid in movement, each with one or more large nuclei; (4) with the growing edge of the blastoderm the underlying "yolk membrane" keeps pace in growth with the spreading germ disk, but never coming outside of the peripheral zone; (5) the "yolk membrane" grows at the same time from the margin to the centre of the disk, and in time it comes to completely separate the blastodisk from the yolk mass beneath it; (6) the blastodisk at about this stage is a hollow hemisphere placed at one pole of the yolk mass, and with the origin of the "yolk membrane" cells underneath the marginal zone, which grow centripetally underneath the blastodisk, presents a phenomenon comparable in all respects to the epibolic gastrula; (7) hence Mr. Watase believes the "yolk membrane" to be necessarily a true endoderm, and its sole representative in the Cephalopods; (8) as to the origin of the digestive tract, with its appendages, he found it to be formed by the ectodermic invaginations, that is, by prolongations of the proctodæum and stomodæum; (9) at no period of the development does there exist any connection between the "yolk membrane" and the digestive tract, and long before the absorption of the food yolk is completed the permanent digestive canal is formed; (10) with the absorption of the food yolk the "yolk membrane" disappears. The yolk membrane is therefore a provisional structure the function of which

[1] Edited by Prof. John A. Ryder, Univ. of Penna., Philadelphia.

[2] Studies from the Biological Laboratory of Johns Hopkins University. Vol. IV., No. 4, pp. 163–181. June, 1888.

is, like that of the periblast or merocytes in fish ova, for the purpose of appropriating the yolk substance. Two admirably drawn colored plates illustrate Mr. Watase's memoir.

Development of the Sea-Bass (*Serranus atrarius*).—During the early part of the month of July last, in the laboratories of the U. S. Fish Commission, at Wood's Holl, Mass., the writer had the opportunity to study the development of this form. The eggs are of the floating or pelagic type, and very transparent, measuring very nearly 1 millimetre in diameter. The buoyancy of the egg is no doubt increased by the presence of a moderately large oil drop which is embedded in the yolk, near its periphery, and at the pole nearly opposite the point where the blastoderm is formed. Hatching occurs at the end of the third day, and the oil drop is pushed toward the cephalic end of the yolk, as the latter is nearly absorbed.

The embryos when hatched present much the appearance of the young Tautog or Mackerel, as respects their transparency, but they soon have their pigment spots arranged in a peculiar way along the edges of the median fin folds. Later, the arrangement of the pigment cells is somewhat different and more irregular, while a second kind of pale yellow pigment cells appear, forming three pretty well-defined transverse bands, at equidistant intervals, across the body and tail of the young fish.

On the Development of the Calcareous Plates of Asterias,[1] is the title of a beautifully illustrated memoir by J. Walter Fewkes on the later history of the young star-fish, which, together with the memoir by Mr. A. Agassiz, makes our knowledge of the development of these echinoderms very complete. Five fine plates illustrate the paper.

Values in Classification of the Stages of Growth and Decline, with Propositions for a New Nomenclature.—Under this title, Prof. A. Hyatt discusses the values of larval and growth characters, introducing a number of new terms.[2]

[1] Bulletin of the Mus. Comp. Zoology, Harvard College. XVII , No. 1, July, 1888. (Studies from the Newport Marine Laboratory.)

[2] Proc. Boston Society of Nat. History. XXIII., 1888, pp. 396–407.

PHYSIOLOGY.[1]

—Dr. H. P. Bowditch, the President, and Prof. H. N. Martin, the Secretary, of the American Physiological Society, are in Europe for the summer. During the absence of Prof. Martin the duties of the Secretary will be performed by Dr. William H. Welch, of Baltimore.

—The opening of the new Marine Biological Laboratory at Wood's Holl, Mass., is an event of more than ordinary importance to physiologists—not so much for what it now is, as for what it promises to be. At present it is devoted chiefly to the study of morphological problems, owing to the pressing demands from morphologists for opportunities for sea-side work, but even now physiologists find themselves heartily welcomed, and in the numerous problems offered by the muscle and nerve physiology of starfishes, jelly fish, sea-urchins and the like; in the question of phosphorescence; in rudimentary sense organs; in reproduction at its simplest; and in a host of still broader questions concerning the physiology of protoplasm, they will find abundant material for prolonged and absorbing study. The famous zoological station at Naples has lately taken steps toward offering opportunities to physiologists equal to those which it has for years supplied to morphologists; and it cannot be doubted that equally brilliant results will follow and will enrich physiology, as morphology has already been enriched. No special facilities have as yet been provided for physiologists at Wood's Holl, but it is the desire and the intention of the trustees to make the laboratory, in fact as well as in name, a *Biological* laboratory.

—The editor of the *Journal of Morphology* had occasion not long since to defend his action in publishing in his periodical an article of a decidedly physiological character, and his remarks, which we quote from a recent prospectus, of the journal, are noteworthy and suggestive for physiologists generally, as well as for the critics for whom they were written :—

"As long as this remains the only journal in our country that offers to publish zoological papers with adequate illustration, it will be both unnecessary and inexpedient to exclude important papers because they do not happen to be strictly morphological. No such rigid test has ever been applied in a journal of this kind, and a little

[1] This department is edited by Prof. W. T. Sedgwick, of the Massachusetts Institute of Technology, Boston, to whom brief notes, communications, books for review, etc., should be sent.

reflection will show that it is clearly impracticable. Many of our best papers must deal with *mixed* problems pertaining no less—often more—to physiology than to morphology. The end of observation is interpretation, and the goal of all morphology lies in physiology, taken in its broadest and deepest sense. Embryology is one of the leading branches of morphology, and yet many of its more important problems are among the highest known to physiology. These problems are at present inseparably connected with morphological work, and hence cannot properly be excluded from a morphological journal. The same holds true in anatomy and histology; for example, in the case of the sense-organs. The physiological explanation of these organs is what we are all striving for, whether we call ourselves morphologists or physiologists.

"So long as morphologists do most of the work, they will command the field, and their discussions and experimental observations will not be out of place by the side of their morphological studies. The time may come when animal physiology can be separated from animal morphology to the same extent that human physiology is now separable from human anatomy, but we are yet a long way from such conditions. For the present we must recognize the fact, that the relations and bearings of a subject often outweigh the logic of conventional distinctions, and sanction what might be construed, as a violation of the letter, though not the spirit, of our terminology."

The fact is that cellular physiology and what might be called microscopic physiology has been given up of late to a great extent by the strict physiologists, who have turned their attention too exclusively towards the physical, chemical and mechanical sides of the subject. This is particularly manifest in embryology—formerly mainly in the hands of physiologists, now mainly given over to morphologists—and above all in the field of protoplasmic and cellular physiology where the leading names—Flemming, Strasburger, Fol, Bütschli, Carnoy, etc.—are scarcely familiar to the average physiologist. Any one who is acquainted with the brilliant work of the physiologists (Heidenhain, Gaskell, Kühne, etc.) must recognize the extreme value of microscopic physiology and, further, must clearly understand that it means quite as much to physiology as microscopic anatomy does to anatomy. Obviously, to surrender this branch of the science by neglecting or ignoring it is, to say the least, to narrow and restrict the whole subject.

—Some experiments lately made by Mr. C. F. Hodge,[1] under the direction of Dr. H. H. Donaldson, at the Johns Hopkins Uni-

[1] Am. Journ. of Psychology, Balt., May, 1888.

versity, may serve to illustrate the importance and the fruitfulness of the methods of microscopic physiology.

Starting from the well-known facts of gland histology and physiology where it has been now for long known that activity and rest produce corresponding visible changes in their contents, etc., the authors sought to ascertain whether some discoverable change in the active (or worked) nerve cell could not also be distinguished.

Hodge reports as a result, that a marked shrinkage of the nucleus occurs in worked nerve cells over those not worked; a shrinkage amounting sometimes to 33 per cent. In brief:—

"1. The nucleus and cell body both decrease in size as a result of stimulation.

"2. The protoplasm of the cell becomes vacuolated as a result of stimulation.

"3. Differences appear in staining."

SCIENTIFIC NEWS.

—Professor A. H. Tuttle, of the Ohio State University, has been elected to the chair of Biology and Agriculture in the University of Virginia.

—Professor Herman L. Fairchild, of New York city, has been elected Professor of Natural History in Rochester University.

—Otto Burbach, known through his investigations of the Foraminifera of Lias, died at Gotha, April 22, 1888.

—Dr. Richard Blochmann has been elected ordinary Professor of Zoology in the University of Königsberg.

—Mr. F. H. Herrick, who has been for several years pursuing post-graduate studies at the Johns Hopkins University, has been elected Professor of Biology at Adelbert College, Cleveland, Ohio.

—The work of the U. S. Fish Commission at Wood's Holl this summer is confined almost exclusively to affording facilities for students to investigate the life-histories of marine animals. The laboratory is under the immediate charge of Dr. John A. Ryder, while among those working there may be mentioned professors and students from Harvard, Johns Hopkins, Princeton, and two Ohio colleges.

—James Stevenson, of the United States Geological Survey, died July 25th. Mr. Stevenson was born in Maysville, Ky. He was the business manager in the field of the U. S. Geological Survey under Dr. F. V. Hayden during its existence, and contributed greatly to the efficiency of its work. He was also a very important agent in securing from Congress the appropriations necessary to its success. His large acquaintance in Congress was always most valuable to the scientific enterprises of the Government departments. He is one of the few persons who ascended the great Teton. He was especially interested in American Ethnology, and made extensive collections in that department. The Report of the Secretary of the Smithsonian Institution for 1881 contains an important report by him. He was also a zoologist of considerable attainments.

—Silas Stearns was born in Bath, Maine, May 13, 1859, and died in Asheville, N. C., August 2, 1888. His early education was received in the schools of Bath.

In 1878 Mr. Stearns visited the Smithsonian Institution, where, by his thorough and exact knowledge of the habits of the fishes of the Gulf, and of their economic value, he attracted the special attention of Professor Baird, Mr. Goode, Mr. Bean and others interested in the study of fishes. Mr. Stearns was strongly attracted towards a naturalist's life. His ambition, however, met with discouragement in the absurd statement made by some one in Washington to the effect that no successful work in science would be possible without a classical education.

In 1880 he was made a special agent of the U. S. Fish Commission and the U. S. Census Bureau, in charge of investigations of the marine industries of the Gulf of Mexico. Few pieces of work have been performed with more accuracy and fidelity than his report to the Census Bureau.

An intimate friend says of him: "To my mind his most striking characteristic was patient persistence. No trouble was too great, no time too long, no discomfort too annoying to deter him from the present accomplishment of any task to which he addressed himself."

Few men engaged in business pursuits have been of such substantial aid to science as Silas Stearns, and few have had so many warm and devoted friends among scientific men.—*D. S. Jordan.*

—Seth Green, the famous pisciculturist and Superintendent of the New York State Fishery Commission, died at his home here at one o'clock August 20th, after a long and painful illness. He was born at Rochester, New York, on the 19th of March, 1817. He began fishing as a business when eighteen years of age. He confined himself principally to the waters of Lakes Ontario and Mich-

igan, and availed himself of all the devices then known for catching fish for market. In 1864 he purchased a portion of Caledonia Creek, and began his remarkable system of artificial propagation. This event in his life, so important to all lovers of fish, both for sport and table, has an interest which is intensified by Mr. Green's own modest account:—

"I first conceived the idea of fish-hatching in 1837 while fishing for brook trout in a stream that was frequented by salmon in Canada. I observed some salmon at work making their nests preparatory to casting their spawn. I watched their operations for two days, and then and there made up my mind that I would hatch fish artificially, and would at some future day attempt it. At this time I had never heard of fish being hatched artificially. I kept the idea constantly before my mind, and took advantage of every opportunity to learn something in regard to it. I did not put my ideas into practice until the year 1864, and as brook trout offered the best inducements, I commenced my operations with them, in which I was very successful, making many heretofore unknown improvements and discoveries in fish culture, one of the most prominent being the discovery of the dry method of impregnation of spawn, which I made the first month I was in the business after the spawning season commenced. In the year 1867 the New England Fish Commission, hearing of my success, came to me and prevailed upon me to go to the Connecticut river and attempt the artificial propagation of shad. Many had tried before and failed. After many vexations and trials, among which was the disbelief and scepticism of the fishermen, with which I had to contend, they believing that I was insane, and treating me as such, and after the failure of numerous experiments, I at last hit upon a plan which has proved a great success, and is now, and will continue to be, the means of replenishing our shad rivers equal to the best they have ever been known."

A Fishery Commission was appointed in New York State in 1868, and Mr. Green was made one of the three Commissioners. Two years afterwards he resigned his position and became Superintendent of the Commission, which owns a hatchery at Caledonia and another at Cold Spring Harbor. The sole ambition of his life, as he himself expressed it, was to make good fish abundant. This in a certain measure he succeeded in doing, and he was everywhere regarded as a benefactor to the poor, the rich, and especially to the sportsman.

—Close to the U.S. Fish Commission station at Wood's Holl, Mass., is the new building of the Marine Biological Laboratory, which was

opened July 10th, as already noticed in these pages. The building is a large but plain two-story structure, noticeable for the number and size of the windows. The ground floor is devoted to elementary zoological instruction. In one corner a small room, partitioned off from the rest, affords a study for the instructor, Mr. B. H. Van Vleck, while all of the rest of the space is occupied by students' tables, aquaria, etc. The upper floor, the arrangement of which is essentially the same, is devoted to investigators, and is under the charge of Dr. C. O. Whitman, who is the director of the laboratory. Various circumstances rendered it impossible to send out the circulars for the laboratory until so late a date that but few could avail themselves of its facilities. There are the present season about a dozen students, equally divided between the two rooms. Notwithstanding the haste with which the building was gotten ready for occupancy it has a fair equipment of all necessary reagents and apparatus. Flowing fresh and salt water are furnished from the pumps of the Fish Commission, but the iron pipes which carry the latter will have to be replaced with some other material on account of rust. The directors have solved the problem of board by opening a boarding house in a cottage (the use of which is given the laboratory by Mr. Fay) where good table board is furnished for $5.00 per week. The property of the laboratory now amounts to nearly $10,000, but it needs several thousand dollars more before it can be placed in the position it ought to occupy.

PALANOC, ISLAND OF MASBATE, PHILIPPINES,
April 29th, 1888.

EDITORS OF THE AMERICAN NATURALIST:—I herewith forward you a third instalment of narrative of our trip to the Philippines, which I shall be glad to have published in the AMERICAN NATURALIST, if you think best. We have now been in the islands eight months, and have three remaining; have visited and made representative collections on eleven of the larger islands of the group, and have four still remaining to visit. We have made large collections in most branches of animal life, and have much which from the data we have in hand appears to be new. We shall be able to make a very good comparative study of the islands from our collection. We are already able to say that the islands can be divided into at least five very distinct areas —that of the west including Paraqua and Balabac; that of the south including Mindanao and Basilan; that of the centre including the the large islands of Panay, Negrus, Cebu and Bohol; that of the west including Samar and Leite, and that of the north of Luzon and adjacent islands. Whether the great island of Min-

doro stands by itself we have yet to discover. Each of these divisions has its own peculiar species of such test families as the hornbills, woodpeckers, tailor-birds, sun-birds, pittas, and kingfishers, and in many cases several peculiar species of each.

Yours truly,

J. B. Steere.

—Editors Naturalist:—Not long since I passed a day at Ward and Howell's Natural History establishment at Rochester, and I was so much interested and surprised, that I have thought that some of the readers of the Naturalist would be glad to know more of this, the most extensive establishment of its kind in the world. I had bought several thousand dollars worth of specimens of various kinds from Ward and Howell in fitting up the museum of the School of Mines and I had found it a great help to be able to obtain at a fair price authentic, reliable material needed to illustrate lectures upon geology and natural history, and not to be procured through any other channel. But until I stopped at Rochester and went through the establishment, I had no conception of the great variety and excellence of the material available for science teaching that was here accessible with the growing interest in scientific studies, and the increasing appreciation of the value of object teaching, that man is a public benefactor who will supply to us at a reasonable cost, all things necessary to illustrate lessons and lectures. This, Ward and Howell can do to a greater degree than any one person, firm or company in the world. This statement may be regarded as an exaggeration, but after considerable experience with the dealers in natural history material abroad, I do not hesitate to repeat it with emphasis. Professor Ward is himself an educated, scientific man, well up in geology, mineralogy and zoology; he also has a passion for adventure and collecting, which has carried him more nearly "all over the world" than any one else of whom I have known or heard. After his stock of the more common things was large enough, he gave himself up for years to the search of rarities. For example, some years since an interest was excited in the structure of *Hatteria*, and many biologists desired to study its pineal eye and other matters connected with its anatomy, but none were to be had; so Professor Ward, as he has often done, organized an expedition to find and obtain the desideratum. In this case it was necessary to search for long distances along the coast of New Zealand before the haunt of this peculiar lizard was reached, and a sufficient number was captured to supply the wants of the museums of Europe and America.

He and his assistants have scoured India, Borneo, Africa and South America for rarities and always with a degree of thoroughness and intelligence that secured success. Recently, when a good

skeleton and skin of the dugong was needed for the Melbourne Museum, it was found more convenient to get it from Professor Ward than to depend upon the efforts of Australian hunters or naturalists.

Ward and Howell have been now for years occupied in efforts to secure the best representatives of all departments of zoology, and in some instances have undertaken to do what no other dealers in scientific material have the resources and intelligence to attempt, namely, the fitting up of complete museums like that presented by Mr. Brooks to the University of Virginia, and the systematic series of Mammalia gathered for the Museum of Comparative Zoology at Cambridge, and the collection of monkeys presented to the American Museum of Natural History by Mr. Jessup.

Professor Ward's interest in his business and his enthusiasm has always outrun his judgment, until he finds himself with a mass of scientific material in quality, quantity and variety beyond the paying demand. No museum in this country has anything like such a display of interesting specimens in all departments of natural science as Ward and Howell have, while the quantity stored in cellars, tanks, store houses, is much greater. It is in fact a liberal education in natural history to go carefully through their establishment.

This includes, first, rooms devoted to minerals, gems and ores, objects with which Professor Ward began, and which have always held a warm place in his heart. Here the display is very fine, finer indeed than in any public or private collection on this side of the Atlantic. Second, the building devoted to geology containing rocks and fossils from various parts of the world. Third, the department of vertebrate zoology, in which are to be found some living animals of special interest but many more in pickle, skeletonized or stuffed. Fourth, the department of invertebrate zoology, which includes a splendid collection of shells, and a collection of sponges exceeding in volume and interest any other known to me. Fifth, the botanical department, which includes the herbarium of the famous Dr. Harvey.

Among the living animals I was especially interested in a group of about two dozen individuals of *Heloderma* (The "Gila monster") which Professor Ward has had under observation and from which he has learned much that is new in reference to their habits.

In the preceding paragraphs I have spoken simply of Professor Ward or of Ward and Howell, it is but just, however, to Mr. E. E. Howell, to say that he is much more than a mere name in the establishment. He is a trained geologist and was for a long time connected with the United States Geological Survey. Naturally, he presides over the departments of geology and mineralogy; his special interest which is also shared by Professor Ward is meteor-

ites, and it has led them to make extraordinary efforts to gather these interesting objects. Efforts which have resulted in by far the finest collection in this country.

To those who know little of Ward and Howell they may seem mere traders, and this letter, a puff of a business house, but they are much more than traders, they are co-laborers in the work of scientific education whose assistance many a teacher has recognized with gratitude; and this letter is an unsolicited appeal to all those interested in the natural sciences to visit an establishment where so much may be learned at so little cost; and to call attention to the vast amount of indispensable material for the museum, the lecture room and the laboratory which Ward and Howell have brought within easy reach and much of which, without their efforts would have been entirely unattainable.

Yours truly,
J. S. Newberry.

—In the American Naturalist for June, 1888, vol xxii., page 537, appeared an article on "The relative weight of the brain to the body in birds," by Dr. Joseph L. Hancock, which it seems, by an oversight of the publishers, failed to bear his name, making it necessary to call attention to the omission.

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SCIENCE-TEACHING IN THE SCHOOLS.[1]

BY WM. NORTH RICE.

THE word "schools" is here used in distinction from the higher institutions—colleges, universities and technological institutes. It will be convenient for us further to distinguish the "high schools" from the lower schools. As here used, the phrase "high school" designates a school whose pupils range from thirteen or fourteen to seventeen or eighteen years of age, and which professes to prepare students for the colleges and scientific schools.

In considering what should be the course of study in the schools, it is necessary to recognize the distinction in scope and spirit between general and special education. By general education is meant such education as is intended to prepare a person for the duties of manhood or womanhood, irrespective of any particular trade, profession, or station in life. By special education is meant such education as is intended to prepare a person for some particular trade, profession, or station in life. The courses of study in the schools must be, in this sense, general. We are not to try in the schools to make biologists, geologists, nor chemists. We are not to make physicians, nor engineers, nor lawyers, nor clergymen. Very few of the children in the schools will enter any of these professions; and, of that few, still fewer are aware of their destiny. But all the children in our schools have the expectation of growing up to manhood or womanhood. They will take their places in the

[1] Address at the meeting of the American Society of Naturalists, in New Haven, Conn., December, 1887, by William North Rice.

ranks of those who earn an honorable livelihood by honest labor, or among those whom vice or improvidence renders a burden to society. Those of one sex, by the possession of the right of suffrage, and those of both sexes, by their share in that informal and unregulated vote which we call public opinion, will in their degree shape the institutions of the land. Most of them will marry, and, by the direct effect of heredity, and by manifold influences of conscious and unconscious education, will mould the character of future generations. All of them must make individually the momentous pilgrimage through this mortal life to the solemn mysteries beyond. The arrangements of the schools must be adapted to the common needs of humanity, not to the peculiar tastes and conditions of individuals. There must be one course for the children of the rich and the poor, the learned and the ignorant. Such an average course will not be the best for every child, but it will be the best practicable for the great body of children. To employ private tutors, and adapt the educational course to the supposed tastes or needs of each individual child, is impossible for the poor, and generally undesirable for the rich. The advantage to the child from being in a class of reasonable size, feeling the stimulus of intellectual competition, and learning the truly democratic lesson that only personal merit can win, is worth (except in case of children of feeble health or very peculiar constitution) far more than any advantage which can come from the adaptation of the work of a private tutor to the child's idiosyncracies. In regard to the necessity of a uniform course of study, the high schools form a partial exception. In the high schools it becomes practically necessary to provide two courses of study—one for those who are preparing for the classical courses in the colleges, the other for those who are preparing for the scientific courses in the colleges and technological schools, or whose schooling is to be finished with the high school. To a limited extent, also, elective studies may be introduced into the high school course.

In the past, two theories have been maintained in regard to the proper aim and spirit of a general educational course. The disciplinary theory is that the object of general education is to train the mental faculties, it being assumed that a vigorous and well-disciplined mind is the best preparation for all work that may be

required of a man. The practical theory is that the object of education is to furnish the necessary information for the guidance of one's conduct in all probable circumstances. Of late it has been recognized that these views are not mutually exclusive, and that a true theory of education must combine the two. The shield is both gold and silver. A right education must be both disciplinary and practical.

But this harmonizing of the once hostile theories has not been effected without important modifications of each. On the one hand, the advocates of the disciplinary theory have come to recognize the truth that mental discipline can be obtained not merely from the study of some two or three subjects, but from the study of almost any subject. It is coming to be admitted that, from the disciplinary standpoint, the important question is not what we study, but how we study. The very same mental faculties may be disciplined, and disciplined in ways remarkably similar, in dealing with the most widely different subjects. The reasoning by which the comparative philologist traces the evolution of languages is strikingly analogous to that by which the comparative anatomist traces the evolution of organic structures. On the other hand, the advocates of the practical theory have been compelled to a broader and higher view of utility than the merely bread-and-butter view. The individual man is at once body and soul; and he comes into relations with the material universe, with his fellow-men, and with that unseen Power wherein nature and man alike live and move and have their being. Whatever may be known or believed with reasonable probability in regard to the human body, and in regard to the laws of that material universe with which it is related,—in regard to the human mind, whether as self-revealed in consciousness, or as indirectly manifested in literature and history—in regard to the Creator, whether made known by the facts of nature, or by a historic revelation—all this aggregate of varied knowledge and belief is in the highest and best sense practical, for it all tends to guide the conduct of life.

The claim of any particular branch of study to a more or less prominent position in the curriculum of the schools must accordingly be tried by a twofold criterion—its power to afford an effective mental discipline, and the practical utility of the information which it conveys.

It would be obviously a waste of time to discuss the practical utility of the sciences of nature. In this age of steam and electricity—this age of aniline dyes and anæsthetics and antiseptics—this age when science is multiplying comforts and conveniences and amenities, stamping out zymotic diseases, and largely increasing the duration of the life which it beatifies and ennobles—no one is so stupid as to deny the utility of scientific knowledge.

A few words may with propriety be said in regard to the disciplinary value of the study of the natural sciences, for in some minds still lingers the superstition that no studies are disciplinary except languages and mathematics.

The natural sciences are unique in their power of training the perceptive faculties. When these sciences are rightly taught, the student is brought face to face with natural phenomenon, which he is required to observe and describe. The perceptive faculties are not, indeed, the highest of human faculties, but they are by no means to be despised. A student who has learned to observe and describe correctly so simple a matter as the form of a leaf, has gained a power which will be of lifelong value, whatever may be his sphere of professional employment. If the student is required to write descriptions of observed phenomena, there may be gained incidentally a discipline in perspicuity and precision of expression, which will be of no trifling value.

The natural history sciences afford an unrivaled training to the powers of comparison and classification. Sometimes, indeed, these sciences have been called distinctively the classificatory sciences. They have been (at least since the publication of Darwin's epoch-making work) vastly more than mere classifications. They are truly dynamical sciences, revealing the processes whereby organic nature has attained its present state. But they are nevertheless in a very important sense classificatory sciences. In no other class of subjects has classification been so minutely elaborated. No student can learn to marshal the array of species into genera, families, orders, classes, and sub-kingdoms, as men are marshaled in the companies, regiments, brigades, and divisions of a well-disciplined army, without acquiring a more systematic habit of thought on any subject which may engage his attention. But the elaborateness of natural history classification is not the only feature of value in this

connection. The student is continually taught to distinguish not only degrees but kinds of resemblance and difference,—to distinguish those features of structure which are adaptive and superficial from those which are typical and fundamental,—to distinguish analogies from homologies. No one can learn to recognize the mammalian character of a whale under the disguise of its fish-like form, or to recognize the crustacean character of a barnacle under the disguise of its oyster-like shell, without becoming in general a sounder thinker.

The sciences of nature afford a valuable discipline to the reasoning faculties. Educators have always endeavored to afford a twofold training in reasoning—a passive discipline, by requiring the student to familiarize himself with examples of reasoning recorded in the works of great thinkers; and an active discipline, by submitting to the student problems for solution, which, if not new to the human intellect in general, are at least new to the intellect of the particular student. The study of mathematics has always, and deservedly, been highly esteemed for the facilities which it offers for both these kinds of training. But the sciences of nature also have their splendid examples of reasoning. An intelligent study of Darwin's "Origin of Species" is perhaps not inferior as a logical praxis to the study of elementary geometry. Indeed, in one respect the former is superior, for the reasoning of natural sciences is more nearly akin than that of mathematics to the reasoning of practical life. And the sciences of nature have their problems in which the reasoning faculties of the student may find an active discipline. Every laboratory experiment should be an exercise in reasoning as well as in observation. A logical interpretation should be required as much as an accurate description of the phenomena. Moreover, the continual inculcation of the doctrine which is the very keynote of science—the doctrine that there is no such thing as chance—that all events are linked together in chains of cause and effect—is itself an education in philosophical thinking and in rational acting.

Not to be ignored is the influence of the natural sciences on the esthetic nature. There are indeed some scientific men—animated cases of dissecting tools and locomotive microscopes—who can contemplate nature without admiring her. But, for most of those

whose attention is attracted to nature, her aspect is multiform, and her speech many-tongued. And the devotee of nature's truth is ever delighted with the rich stores of nature's beauty. It is no mere accident that the same generations of mankind that have developed the sciences of nature have developed two new arts—landscape-painting, and the poetry of nature. There is inspiration for the imagination, as well as satisfaction for the understanding, in the contemplation of that far-reaching reign of law which is at once the fundamental postulate and the crowning induction of science. The old myth of the music of the spheres is only a parable of the all-pervading harmony of natural law.

Nor is the study of science without its wholesome influence upon the moral nature. Science is indeed no patent panacea for human depravity; but no one can become imbued in any measure with the spirit of science—the spirit of unselfish, courageous, reverent truth-seeking—without some degree of moral uplifting. I believe that a comparative study of biography will show that flagrant immorality has been exceedingly rare among scientific men—much rarer than among men of equal intellectual eminence devoted to literature, art, or almost any other pursuit. Literature and art may express and incite the basest passions. Science—truth—is never impure.

The claim of natural science to a prominent position in the educational course is now pretty fairly conceded in the higher institutions of learning. The most conservative of the colleges are making liberal provision of instructors and of material facilities for the teaching of the sciences, and the student is required or allowed to devote a large share of his time to this class of studies, while numerous scientific schools are open for those students who wish to devote a still larger share of their time to scientific study. The case, however, is very different in the lower schools. Somewhat of science is usually taught in the high schools, though not, as a rule, to those who are preparing for college. But in the lower schools there is usually little or no teaching of science. The result is that those whose educational course ends before they reach the high school (the great majority of the population) receive no instruction in science whatever, and those who receive a college education (the destined intellectual leaders of their generation) receive no instruction in science until a very late period in their educational course.

This exclusion of science from the early stages of education, and (for the great majority of the population) the consequent utter exclusion of science from their educational course is, I believe, the worst feature of our present system of general education. The introduction of science into the lower schools is the educational reform most urgently demanded.

One important reason for this reform is implied in what has been already said. If any knowledge or appreciation of science is to be generally diffused in the community, it must be by the introduction of instruction in science in the lower schools. Of the scholars who enter the primary school, only a small part reach the grammar school, and a far smaller part reach the high school. When we consider that the "people are destroyed for lack of knowledge"—that the preventable mortality due to simple ignorance of hygienic laws exceeds the slaughter of the bloodiest campaigns;—when we consider that not only is the duration of life lengthened, but its comforts and means of higher development prodigiously increased, by scientific knowledge;—when we consider that each man's knowledge or ignorance may not only affect for weal or woe himself and his own family, but may involve results whose ramifications in space and time are beyond our ken:—we cannot fail to recognize the importance of providing for all our population the means of gaining some acquaintance with those branches of knowledge on which the welfare of humanity so largely depends.

Another reason for this reform, though less obvious, is perhaps even more important. A sound system of education must take account of the natural order of development of the mental faculties. Nor need we be in any doubt as to what that order is. The perceptive faculties are the earliest to be developed; later come into activity the powers of abstract thought; later still does consciousness become reflective, and reveal the world of mind. The attention of a healthy and normally developing child is given almost exclusively to the phenomena of the external world. The questions which he asks his parents and other adult friends (if he has not been snubbed too many times in such questioning) relate almost exclusively to objects of sense around him. There are, indeed, miraculous children who speculate about the nature of the soul almost before they molt the long dresses of babyhood; but such

children usually die of precocious genius or early piety on the brain, and may therefore be disregarded in any discussion of general education. Young children in process of normal development are what some one has called the Buddhists—"unconscious materialists." They do not disbelieve in a spiritual world; they ignore it.

The early development of the perceptive faculties produces in the young child's mind a natural curiosity in regard to sensible objects, and therefore a natural aptitude for their study. There are three ways in which we may deal with this mental tendency. First, we may leave the child's curiosity about the external world to unrestrained and unguided indulgence. We may let the child run wild through field and forest, chase butterflies, rob birds' nests, and fill his pockets with caterpillars. He will grow up a young savage, with somewhat of a savage's field-craft and wood-craft, but with very little of valuable intellectual development. Secondly, we may repress the child's natural curiosity. And, in fact, that is about what is usually done. The child is taught to read as early as possible, and then the idea is sedulously inculcated that reading is the straight and narrow way that leadeth unto intellectual life. The story of Sir William Jones's mother answering all her son's questions with the words, "Read, and you will know," is told with express and implied enconiums upon her wisdom and her son's consequent vast erudition. Verily, the ghost of that good woman haunts our schools like a malignant spirit. The climax of success is reached when the little monk is snugly cloistered with his books, oblivious of the very existence of a world of light and music around him. And if he grows up to be one of the favored few who are permitted to enter the sacred precincts of the college, and there take up the long-deferred study of nature, he finds too often his powers of observation well-nigh atrophied by long disuse. I speak strongly, because I speak from experience. I feel daily that the efficiency of my work as a student and teacher of science is impaired by that vice of early education which repressed, rather than developed, whatever powers of observation nature had given. My professional life has been a perpetual struggle to rid myself of some of the mental habitudes induced by an unnatural education. I have not yet quite freed myself from the influence of Sir William Jones's mother. And what I have felt in myself I have seen in my students. It is

worse than making bricks without straw, to teach natural science to college juniors and seniors, in whom disuse has wrought so complete an atrophy of the powers of observation that they hardly know that there is an external universe.

Manifestly, the only right course in education is to furnish intelligent and sympathetic guidance to the child's natural curiosity. The study of nature should be introduced at the beginning of the educational course, instead of near its end. It should commence—not in the primary school, but in the nursery, before the child is old enough to go to school at all. A vast deal of knowledge may be smuggled into the child's mind without paying any duty of conscious toil. And such smuggling is forbidden by no laws of God or man. No child is hurt by knowing too much; though many a child is hurt by learning things in unnatural and unduly laborious ways. Whatever of useful knowledge a child gets while he thinks he is playing is clear gain. The sentiment,

> "No profit grows where is no pleasure ta'en,"

may not be strictly true, but there is at least an important truth in it.

Some years ago I had the pleasure of a somewhat intimate acquaintance with a boy who, in his third summer, became very much interested in flowers, or, as he called them, "sowers," for at that time his language, besides being very scanty in vocabulary, presented some marked dialectic peculiarities. Having obtained some specimens of the tawny day-lily (*Hemorocallis fulva*), he noticed the long slender bodies in the middle of the flower, and he asked his mother what they were. It seemed almost absurd to be teaching botany to a baby hardly more than two years old, but his mother, having large faith in the general principle that the best way to answer a child's questions is to tell the truth, told him that the things he had found were the stamens and pistil. Of course the baby did not know much about the objects which he examined. It was not time for his brain to be disturbed with matters of morphology and physiology. It was not time for him to learn that stamens and pistils are peculiarly modified leaves, or that they are respectively the male and female organs of reproduction. But his eyes were often busy that summer in looking for the stamens and pistils in various flowers, and in that simple matter of observation

he succeeded quite as well as some college juniors I have seen. And when, in after years, the time came for him to take up the study of botany more systematically, the objects of his study were to him not dim and unreal phantoms, but familiar friends.

To be continued.

FIGURING AGAINST WEEDS.

BY BYRON D. HALSTEAD.

THE weeds are among the worst enemies of the farmer. They cause a loss of many millions of dollars annually to the State of Iowa. This is not only in the diminution of crops but no small share of the outgo is in labor in order to prevent an entire loss of the crop.

Some persons, who as yet have secured no world-wide reputation for keen common sense, are inclined to look with much favor upon weeds. To their visionary minds they are simply a proper stimulus for the profitable tillage of the soil, and therefore may be considered as the friend instead of the enemy of the progressive farmer. If it were not for the weeds, which spring up and choke the neglected crop, there would not be sufficient incentive to good husbandry. Good and poor farming would be more equally rewarded. The man who hoes and the one who leaves his corn field for the shade and game along the wooded stream would stand a common chance of plenty at the harvest time. In short, weeds are the appointed means of putting a premium upon farm industry and furnish one reason why it does not pay to be shiftless.

This is turning the curse into a blessing, and if every one would practically make this turn there would need to be but little more said.

Weeds are a good deal like the sun and the rain in relation to the just and the unjust, with perhaps this variation, that the weeds seed abundantly on the neglected land of a shiftless farmer and these same seeds find their best places for growth in the clean rich fields of the careful husbandman.

But all this aside; it is true that the State of Iowa has already more weeds than she wants for the purpose of premiums. Her good farmers get enough encouragement for being good without having their less prosperous neighbors loaded down with a heavy weight of thieving weeds. I for one would be willing to risk the quality of Iowa agriculture if every vile weed within our borders was rooted out and all their seeds burned to smoke and ashes.

The conditions which surround our prairie farming, foster the growth of weeds. Land has been very cheap and at the same time very rich. The first fact has encouraged a spirit of carelessness on the part of the farmer and the second has permitted the rapid multiplication of rank weeds. As a result our State is becoming almost overrun with plant-pests of both the field and the garden.

The time has come when an earnest study must be made of the weeds which rob our land, already losing much of its virgin fertility. We must come to the rescue while the enemy is comparatively weak. Education is more effective than legislation. It is not difficult, perhaps, to pass a law against cockle-bur, beggar's lice, Canada thistle, etc., as has been done in many States, but an act of the legislature does little good until there is a keen appreciation of the importance of clean fields and road sides, already in the minds of the farmers.

With a view to becoming better acquainted with the weeds and useless plants of the State, a list has been prepared which embraces: (1) all the worst weeds, (2) the bad weeds, and (3) the indifferent weeds. The first class includes fifty-one (51). In the second group are ninety-four (94) kinds; and among the indifferent sorts are one hundred and fifty-two (152) species. This gives a total of two hundred and ninety-seven (297) distinct kinds of plants of no great usefulness to the farmers of the State, half of these a positive disadvantage and over half a hundred being pests of the worst sort. When thus arranged the enemy makes a long and bold front.

If we look at these enemies in the light of their term of life—as the horseman would say, look in the mouth, it is found that eighty-four (84) are annuals; twenty-seven (27) are able to live two years at the most, while one hundred and eighty-six (186) are perennial, that is, thrive for an indefinite term of years. These figures can be readily thrown into a tabulated form suitable for the blackboard, thus:—

	Annuals.	Biennials.	Perennials.	Total.
Worst weeds	28	6	17	51
Bad weeds	34	12	48	94
Indifferent weeds	22	9	121	152
Totals	84	27	186	297

If we look up the pedigree of these pests it will be found that they are divided into eighty-seven (87) foreigners, which have come from abroad to infest American soil. The large balance of two hundred and ten (210) are natives and are weeds in their wild state or have made inroads upon cultivated land. Of the 87 foreigners, forty-four are annuals, that is, running through their whole life in a single season, twelve (12) are biennials, and thirty-one (31) are perennials. Twenty-eight of the eighty-four are in the worst class, thirty-seven in the bad group, and twenty-two belong to the indifferent order. A table of the imported species may be constructed as follows:—

	Worst.	Bad.	Indifferent.	Total.
Annuals	18	19	7	44
Biennials	3	6	3	12
Perennials	7	12	12	31
Totals	28	37	22	87

Taking up the 210 native species in the same way, the table stands as follows:—

	Worst.	Bad.	Indifferent.	Total.
Annuals	10	16	14	40
Biennials	3	6	6	15
Perennials	10	35	110	155
Totals	23	57	130	210

From these tables it will be seen that of the worst class—which of course most interests us, there are twenty-eight foreigners to twenty-three native species. It is no comfort to know that more than half of our most aggressive weeds have come, or been brought, to us from some other country. If there is any satisfaction in the thought, it may be here stated that some inoffensive American plants have gone abroad and became dreadful pests in their new surrounding. In this way we compensate in part for the additions made to our list of weeds from European and other lands.

Beginning with the foreign annuals the leading worst kinds given in the order of arrangement in Gray's Botany, are: charlock or yellow mustard, shepherd's purse, corn cockle, purslane, abutelon or velvet leaf, sun-flower, mayweed, Jamestown or jimson-weed, two species, goose-foot or lamb's quarters; pig-weed, tumble-weed, chess and three kinds of fox-tail grass or "puss-tail."

The three foreign biennials are the common carrot, parsnip and the hound's-tongue. Two of these are closely related and have escaped from the vegetable garden where they are very important root crops. The carrot and parsnip are not as bad weeds in Iowa as they have become in many parts of the East where they cover the pastures and meadows with useless herbage.

Of foreign perennials the leading worst sorts are Canada thistle, dandelion, rib-grass or narrow-leaved plantain, butter and eggs, toad-flax or ramstead weed, curled-dock and sorrel.

Coming now to the native weeds of this most injurious class we find among the annuals the following: Daisy fleabane, great rag-weed, Roman rag-weed, cockle-bur or clot-bur, beggar's ticks, horse nettle, beaked horse nettle, prostrate pig-weed, knot-grass and bur-grass. It will be seen at a glance that this is a formidable array of bad enemies.

The biennials are the evening primrose, a kind of fleabane or horse-weed, and the viper's bugloss or sometimes called blue devils. This makes a strong three-horse team.

Of the native perennials may be mentioned the callirrhoeä, two kinds of iron-weed, three sorts of thistles, namely: the ball thistle, common thistle and pasture thistle, the bracted bind-weed and quack or quick-grass.

By turning the figures of the tables to further service, it may be shown that there are nearly twice as many foreign weeds of the worst sort as of the natives. Twenty-eight out of the fifty-one live for only a single year. Six only are biennials and seventeen are perennials. This we should not expect because other things remaining the same a perennial is a worse weed than an annual. But other things do not remain the same. The annual is usually characterized by great capacity for forming seed, and this advances many of the annuals to the first rank among plant pests. For example, the common purslane will mature a million seeds in a

single season or enough to thoroughly stock a country with this pest. A student made a careful estimate of the seeding capacity of a single plant of the small veronica, called niclace speedwell, and found that the number of seeds was 186,292. These figures help to force home the thought that weeds, and especially these sorts which are dependent upon seeds for their continuation, are exceedingly prolific, and also the importance of keeping such pests from maturing their offspring.

When asked to select the most offensive among the worst weeds the task becomes an exceedingly difficult one. Among the annuals, especially in gardens, the purslane or " pusley " perhaps takes the lead. In striking contrast with the prostrate purslane is the shrub-like Jamestown weed or stramoniums, sometimes called jimson weed. The rank herbage and heavy order of these coarse weeds, as well as their larger size, make them conspicuous and disagreeable. The pig-weeds and the closely related tumble-weed are common coarse intruders into the tilled ground.

Of the biennial the most to be dreaded are the carrot and the fleabane, both of which, in their own widely different way, can do much to render the life of the farmer vexatious.

The worst foreign perennial, at least the one with the most meanness in its make up, is the Canada thistle. At present it is but little known in many parts of the State; but it spreads rapidly by means of its airy floats which bear the light seed for long distances, and when once established in the soil it holds its place with an almost undying grip. The long perennial roots strike Iowa deep into the soil while the prickly herbage defies the attacks of foraging animals. The curled-leaf dock also takes a firm hold and is eradicated only by being dug up by the roots and hung in the sun or burned. Of the native perennials there are various sorts of coarse thistles and the celebrated quack or quick-grass. This last is a remarkable instance of propagation by undergrown stems. Plowing and harrowing only aids in the spread of this pest. Each piece of wiry stem when given any sort of a chance will grow and develop the weed.

As a rule the weeds of all classes should never be permitted to mature their seed. With annuals this is a quick and effective means of eradication. The biennials will perish at the end of the

second year. Perennials may live on for several years but if they are not allowed to develop much herbage and no flowers the old plants will gradually die of starvation and, being without heirs, they will leave the land to revert to its rightful owners.

Proper tillage will keep the weeds within safe bounds in the open fields of hoed crops. By proper tillage is understood that culture which the crop demands even when no weeds encumber the soil. The hot-bed for weeds is the neglected corners where the cultivator and hoe do not naturally go. It is in such places, along road-sides, barn-yards, open wood lots and fence corners that weeds sneak in and bear their young. It will be difficult to keep the cultivated field clean when all around is breeding ground for foul seeds.

Rome was not built in a day and neither will our weeds be destroyed in a generation. It is only hoped that, as all roads lead to Rome, so may all the inward desires and open acts of every producer of crops tend toward the destruction of our worst weeds.

THE CENTRAL PHILIPPINES.

BY J. B. STEERE.

(Concluded from page 626.)

AFTER much enquiry for a suitable place to collect in, we heard of virgin forest in the north part of the island of Panay, and finding a little steamer running up the coast we took passage to the village of Concepcion, some twenty miles north of Ilo Ilo, and nearly in front of the curious conical island called Pau de Assucar. Woods were in sight, but we found that they were steep and rocky, and difficult to hunt in, and rather unproductive of forms new to our collections, most of the birds being identical with those already procured in Guimaras. The forest had a curious half-dead appearance, which was due in part to most of the leaves having already, in January, fallen, preparatory to the coming spring, and in part to much of the timber having been injured by large gashes in the trunks to collect the gums from them. Before we left the place some of the trees were already showing the purple and bright yel-

low tints of the new foliage. Spring does not come all at once, nor to all plants at the same time, here; but I think that even here in the tropics every plant has its annual period of rest from growth, of leaf-shedding, and of spring, though there is no long period of time, as with us, between the last two processes, the new growth here usually crowding off the old leaves, though a few species, like some of the wild figs, are bare for some time before the appearance of the new leaves. These have in some instances led us to believe them dead from their bare appearance among the universal green.

The country along the coast at Concepcion was hilly and unproductive, and uncultivated, and it was a mystery how the people existed, until we followed the roads leading back into several large level valleys which had been brought under cultivation, the lower parts, which could be flooded, to rice, and the higher to sugar cane. A few Spaniards and Mestizos had settled here, and were hauling their new sugar in buffalo carts to the coast for shipment. We passed several great sheds which served as sugar-mills, the machinery being in some cases upright wooden rollers turned by buffaloes, in others, small steam engines imported from England. On the wet rice grounds, now grown up to weeds and grass, we shot a few rare water fowl, among them the great blue and purple heron of the Philippines. At a village on one side of one of these valleys we found a roost of fruit bats. Three or four acres at one side of the roadway, grown up to scattered clumps of bamboo, and in the bending tops of these the bats were clustered. The immense masses of small prickly branches, at the bases of these clumps, curve downward, and make thickets hard for man or beast to pass over or through to the trunks beyond, and they appear to be chosen by the bats for this reason.

We passed at least four distinct species of fruit bats inhabiting this grove, though each species was found by itself in particular trees. As we approached them, about noon, they hung, in perfect quiet, head downwards, by both hind feet, the wings being folded about the body so that they looked like clusters and strings of great pendant birds' nests. They were accustomed to the people of the village passing beneath them, and paid no attention to us until we began to shoot among them, when they rose squealing

into the air. After wheeling around like spectres over our heads for awhile, they would approach a perch, and throwing the hind feet forward, would grasp it, and fall down into their accustomed position. After they became alarmed they would take flight at our approach, and they appear to see fairly well by day. A few shots were sufficient to fill two large baskets, and made a good load for a native who carried them back to town. The next day, while skinning them, we had frequent visits from the villagers, who carried off the bodies to eat. They have a strong, disagreeable, bat odor, but are said to be good eating. The larger species were from fifty-four to sixty inches in spread of wing, the smaller ones about forty. They fly to great distances in their search after food, leaving their roosts at dusk and returning just at daylight in the morning. They become a great pest to the natives, though they may be benefactors in disguise, by nightly visiting the bamboo cups in the coco trees in which the sweet juice of the flower stems is being collected for *tuba*, the beer of the country, as the people are fond of calling it. Sometimes the bats take this when it is too much fermented, and the next morning finds them rolling about on the ground under the coco trees instead of on their way to their roosts, and there they are at the mercy of any crow that wishes to tear holes in their wings with his beak, or of the swine that make a meal of them. We were brought several which were caught drunk. From an examination of the stomachs of those collected, this coco juice seems to be their chief food, and must in time have its influence over their anatomy.

Having completed our work in Panay and Guimaras, we embarked again on the 1st of February, and running down around the south end of the great island of Negros, landed at Dumaquete, a clean little town just opposite the southern point of Cebu, and so near that island that we could see the trees across the strait. The south end of Negros had appeared, as we passed around it, a great stretch of grassy plains and hills, now dry and yellow, and being burned over in some places. The mountains approached nearer at Dumaquete, and we could see forests on their heights. They were volcanic, and what we judged to be ancient lava streams extended down from a height of two or three thousand feet to near sea level, and with such an even grade that they looked like gigantic railroad embankments.

We found at low tide a great number of beach-inhabiting bird-on the flats north of Dumaquete. There were many species of curs lews, plovers, stilts, sandpipers, oyster catchers, etc., all in flocks and most of them probably migrants. After we had procured all of these we wished the party divided. Three of us took a native boat and sailed across to the little island of Liquijor, where they made a good collection of birds, two or three species of which appear to be peculiar to the island. They also found sea shells abundant, and among other rarities procured a living pearly nautilus. The rest of the party went north along the coast of Negros and the strait of Tañon, and stopped at the village of Sibulau, near the foot of the mountains. Birds were abundant in the wooded ravines, but though we procured many species we had not seen in Pauay and Guimaras, they were apparently such as depended upon a more favorable location, and not upon a real change of habitat, for the hornbills, woodpeckers, tailor-birds, pittas and sun-birds, which we had learned to look upon as test species, were identical with those from the islands named.

Hearing of some unexplored mountain lakes to the west of us, we made a trip inland in search of them. At a height of fifteen hundred feet we reached virgin forest, among which were fine tree ferns in abundance. The whole country was steep, but the natives were plowing in and cutting off the timber from the steep mountain sides, and planting them to *abaca,* the so-called Manila hemp. This is a species of banana, and looks so much like those planted for their fruit that we had difficulty at first in distinguishing them, but the abaca thrives best in a cool and moist situation. We found it afterward growing luxuriantly at a height of three thousand feet, while those varieties used for food thrive best near sea level and in the greatest heat. Like the other bananas, the abaca forms a trunk from eight to twenty feet high, made up chiefly of the bases of the leaves, these wrapped one over the other, and it is these which are made use of. They are torn apart, and the outer covering of the outer or convex side is stripped off. This contains the fibre, the the rest of the leaf base being made of large watery cells. It is drawn through a wide machine made on the spot by the Indian cultivator. This has wooden jaws, between which the watery cells among the fibre are torn and pressed out while the fibre is drawn

through. The hemp comes out white and glistening, and requires no other preparation but drying to fit it for baling and shipment. Through the fall in price of sugar, hemp is now the most important article of export from the islands.

We reached a height of three thousand five hundred feet, the path leading for most of the way along the narrow crests of mountain ridges. Oaks were plenty at these heights, and with them Indian pitcher plants, a beautiful colored leafed begonia, a colens in in flower, and a great number of ferns, and mosses. Everything was dripping with moisture, and land leeches were crawling over the ground or hanging from the plants ready to drop upon us. The lakes were small—one a half mile, and the other perhaps a mile in length, and at a height of about three thousand feet. They were in steep ravines between mountains, so that there were no valleys about them in which we could hunt. A step from shore on any side took us over our heads in water. Deer and wild hogs were abundant, and our Indian hunters tried to drive them into the lakes with their dogs, but without success. The only life we saw in the water of the lakes was leeches, of great size, and crabs and water-fowl were almost absent. A few great hornbills were flying from one mountain crest to another, but it was folly to attempt to follow them.

We found a little piece of level ground at the mouth of a mountain brook, where we built us a shelter and camped. We shot a few species of flycatchers from the trees over our hut, and after staying two days, and sleeping cold with the themometer 67°, we descended to the coast. While some of the party went on to Cebu by steamer, a division crossed the strait of Tañau to Cebu, and followed the west coast of that island to the town of Barili, then crossing the mountains to the east coast followed this to the north until we reached the city of Cebu. This is the oldest Spanish town in the islands, and is the capital of the island and a port open to foreign trade.

We found the island of Cebu still more thoroughly stripped of its timber than the islands to the west, but after doing what we could to get a fair collection of its birds we concluded that it, too, belonged zoologically with Negros and Panay. A brief visit by two of us to Bojol convinced us that this, too, must go with the islands to the

west of it in a division which may well be called the Central Philippines. Bojol and Cebu have large amounts of limestone rock thrown up in steep ridges, and this has probably caused their great richness in land shells, of which each valley seems to possess a species. The shallow strait between these islands is rich in sea life, and a week spent in the little island of Waiming produced a fine collection of corals, echinoderms and sea shells. Crinoids were abundant in the shallow water, and of several species; they were usually partly protected among the branches of living corals, but sometimes fastened, mouth upward, to stones and coral masses. An immense spiny star-fish was slowly crawling over the coral stems, digesting the polyps as he went, and leaving a broad white track of dead coral behind him. Returning to Cebu, we packed our collections, and left them to be forwarded by sailing ship to New York, and took passage on the last of March for Saman and Leite, the most eastern islands of the group.

THE DERIVATION OF THE DOMESTIC POLLED BREEDS.

BY R. C. AULD, F. Z. S.

(Continued from page 509.)

WHAT part had these polled cattle of the parks in the origin of the existing domestic breeds of Britain, now so numerously represented in this country? Instances have been enumerated of the existence in widely scattered places of polled cattle of various descriptions. Out of all these did any survive and become aggregated more into certain localities, and thence evolved into separate and distinct breeds? The connection of the park cattle with these breeds of polled cattle in their former and present state will here be traced.

Sir Richard Owen, in advocating his theory as to the origin of British cattle, which is at variance with that of Darwin, Lyell, Nilson, Rütimeyer, etc., says: "Had the *Bos primigenius* been the same we might have expected the Highland and Welsh cattle to have retained some of the characteristics of their great progenitors,

and to have been distinguished from other domestic breeds by their superior size and the length of their horns. The Kyloes and the runts are, on the contrary, remarkable for their small size, and are characterised either by short horns, as in the *Bos longifrons*, or the entire absence of these weapons."

With all due respect to Sir Richard, exception must be taken to his ideas as to the characterisation of the Welsh and Highland cattle. Has he ever seen either race at the Smithfield Show at London, or other National Shows, or on their native heath? If he had he would not have fallen into the error of characterising these cattle as of small size, or short horned, or wanting in the characteristics of their progenitors, the Uri. If he had seen them as they may be seen, he must have been convinced that they do possess the strongest claims to such descent of any existing race, in respect of size, length of horn, and general characteristics. This is the common error that many have fallen into, not having seen representative or real specimens of the breed. How many animal forms have not large and small associated varieties or species? This needs no illustration. Besides, "size" depends not always on species, but on environment. That these small and large Scotch horned correspond respectively with *longifrons* and *urus*, we believe, however, is true.

Contrast with Owen's ideas the practical knowledge of Professor Low. In his "Domesticated Animals" he says: "These English White Forest breeds have merged in the common breeds of the country." He believes, however, that the same animals are yet to be found in that part of the Kingdom where we should naturally look for the existence of an indigenous race of cattle, *viz.*, beyond the Severn, in Wales, and in the West Highlands.

"The mountain breeds of Scotland," he says, "are identical with those which formerly inhabited the woods of that country, which, we have seen, were the ancient Uri, and which we may term the White Forest breed." He has also some excellent remarks on the comparative size of the Urus and his modern representative, which are too long to quote. But he says: "The size of the Pembroke cattle is that of the larger class of the breed of the West Highlands of Scotland"—which corresponds with all practical breeders' knowledge on the subject.

We may leave Low here with the following quotations: "Thus we have all the evidence which the question admits of, that no real distinction exists between the wild oxen of the parks and those which have for ages been subjected to domestication in the same country, and that these wild oxen are no other than the Uri of the ancient forests of Europe."

"Thus were the Uri of the Scottish forests driven from the woods which they inhabited, destroyed, or made captive. Part, indeed, had been preserved in some of the religious houses, their flesh being more esteemed than that of 'their ain tame bestial.' But with the destruction of the ancient establishments, the oxen were dispersed, destroyed, or mingled with the common races. In a few places only they seem to have been preserved without intermixture—chiefly in the parks of the Dukes of Queensberry at Drumlanrig, and of the Dukes of Hamilton, at the Chace of Cadzow. Those at Drumlanrig were, many years ago, destroyed by order of the late Duke of Queensberry. Those at the noble park of Hamilton are yet in existence, preserved with care." He describes them as "indubitably descendents of the ancient race," and as to their size says they are in that respect the same as the cattle of the West Highlands.

For convenience I continue from last chapter the consideration of the Scottish parks. And it is necessary in this investigation to examine these somewhat closely, so as to obtain a proper definition of their limits, and to exhibit the direct connection they had with the polled breeds of to-day.

Sir W. Jardine, Bt., (Naturalists' Library, Vol. IV.), makes these remarks in describing the "White Urus, or Hamilton Breed of Wild Cattle": "The Caledonia Sylva, or Caledonia Forest, extended from Stirling through Monteith and Strathorne to Athol and Lochaber. It is described by old authors as dividing the Picts from the Scots, and, being well furnished with game, especially with the fierce white bulls and kine, it was the place of both their huntings and of their greatest controversies. The Roman historians delight much to talk of the furious white bulls which the Forest of Caledonia brought forth. . . . . At what period the present breed was introduced to the royal chase at Cadzow cannot now be well ascertained. It is well known that the Cummings [Earls of Buchan] were at one period proprietors of Cadzow and Cumber-

nauld, and it is likely that in their time the white cattle were in both places. But, be that as it may, they have long been extirpated in Cumbernauld, while they have been preserved in great perfection at Hamilton."

This description of ancient "Caledon," given by Jardine correctly from the earliest historians, should be remembered. For, more latterly, authorities, even such as Sir Walter Scott, described the Caledonian Forest as extending over a territory of which "Cadzow and Chillingham are but the extremities," "which in ruder times was a continuous forest, the white cattle being the remnants of those herds of *Tauri sylvestres*, described by early Scottish writers as abounding in the forests of Caledonia."

This latter region, as a look at any map showing the boundaries of the different regions in these early times [1] will show, was the ancient Strathclyde—the western portion of southern Scotland and northern England, the adjacent portions on the eastern side of England and Scotland being Northumbria, while "Caledonia," so says the writer in the Encyclopædia Britannica, "lies to the north of the Forth," but must include the region of the Clyde which flows north. This Caledonia in the west—called Dalriada—came to be inhabited by the Irish Scot or Gael, while the east remained Pictish. These Dalriadans were the *great* Scots about whom historians have had so much to do. The Galloway, "Wild Scots," were afterwards conquered by the true Scots of Dalriada, the name Galloway not indicating the composition, but the conqueror, of the Pictish inhabitants. The Pict, that is, of the east or northeast, "came from Scythia—that is, North Germany—as their own legends tell, which was undoubtedly peopled by Celts before it was peopled by Germans."

Let us, then, look at the park herds in Scotland—the Hamilton, the Ardrossan, the Drumlanrig. The first is located in the great Caledonian region defined by Jardine, Storer, Harting and others, as above. The two last belonged to ancient Galloway. The Ardrossan and Drumlanrig (Duke of Buccleugh) were *horned;* the Hamilton was *polled.* The significance of these facts will appear when the history, literature and philology of the two regions are examined.

[1] See Skene's "Celtic Scotland."

The parks became enclosed in ancient times, and with the enclosing the wild cattle became enclosed also. These cattle were the Uri of the north, whose originating source was the ancient cattle of Cumbernauld, near Stirling. These then became extinct, having been scattered, part being preserved in the polled cattle of Hamilton.

"The wild bull of the north had, therefore, anciently free access to the whole of southern Scotland, and to the mountains, wastes and forests of northern England also."[1] The Cumbernauld extinct herd "thus connects north and south; the wild bull of the old Caledonian Forest north of Stirling with the Hamilton wild cattle, and with those which inhabited, as described by Scott, the continuous mountain ranges and the innumerable forests which formerly extended from Hamilton to Chillingham." Hamilton was thus near the fountain-head. Their representatives at Cadzow, and over the north, were polled. This territory was the pasture region of the polled cattle of Fife, Angus, Aberdeen, etc. At Drumlanrig, in the pasture ground of the Galloway, they were horned—in that indicating the character of the original Galloway breed.

Take now the Hamilton cattle possessing as its hunting ground all northward. These were the famous white bulls of Caledon, descended, as all authorities agree, from *Bos urus;* and which were also by all historical accounts polled. This herd belonged, before the days of the Bruce, to the Cummings—the great but unfortunate Earls of Buchan.

But further, Hamilton Palace was the seat of the Douglas-Hamiltons, Dukes of Hamilton and Brandon, who represented through the male line the great Douglases, Earls of Angus. Here, therefore, we have the Hamilton (Cadzow) herd connected in the closest manner with the shires of Aberdeen (Buchan) and Angus. Hence are traced the roots of the Aberdeen-Angus breed of polled cattle, firmly spread over the more lowland portions of the Caledonian region. And it is a further historical fact that it was from royal Kildrummy, in Aberdeenshire, after his spoliation of the Cummings, that King Robert the Bruce, in the thirteenth century,

[1] See "Wild White Cattle of Great Britain;" *also* "Domesticated Animals of Britain."

issued to hunt the wild bulls of the Caledonian forest, which region extended thus from royal Kildrummy to royal Stirling.

The origin of the name Caledonian is derived from the word *Calder*, signifying the hazel brush. In the Transactions of the Highland Society, Vol. XVII., 1885, it is stated that in Lanarkshire, in which the Hamilton herd is situated, "fifty years ago some had cows of the native or Calder breed; others crosses with these and Ayrshires." The word *Kyloe*, also, is derived from the name of this forest region, the word meaning *cows of the woods*—both words having one root in common.

The Drumlanrig and Ardrossan herds are extinct. These herds were horned [the latter having latterly become polled on the introduction of polled bulls from Hamilton.] And just as the Aberdeen-Angus had their roots in the Caledonian polled varieties represented by the Hamiltons, so had the Galloway its foundation from the same horned cattle that became enclosed at Drumlanrig.

Drumlanrig Castle, in Dumfriesshire, is located in the valley of the Nith, between Hamilton and the Firth of Solway, but nearer the latter. The owners of this castle were that branch of the house of Douglas which enjoyed successively the titles of Earls, Marquises and Dukes of Queensberry. The Duke of Buccleugh, as heir general, is Duke of Queensberry, and possesses Drumlanrig.

While, as will be seen, Hamilton was transferred to the Angus-Douglases on the extinction of the Comyns by Bruce, Cumbernauld, likewise owned by the Comyns, became transferred by Bruce to Sir Robert Fleming, who was the ancestor of the Earls of Wigton, and it was probably during the time of Queen Mary, when the Flemings were out of favor at court, that the remnants of the Cumbernauld herd got dispersed, and some might have been transferred to Dumfriesshire.

Anyhow the Drumlanrig herd also went by the name of the *Wild Caledonian Cattle*. They were white with black points. Mr. Dickinson, in his Essay "On the Farming of Cumberland," published 1852, identifies the Drumlanrig cattle also with the Caledonian Forest Wild Cattle. The herd has been long extinct. Drumlanrig was located at the foot of these wild hills, which extending throughout southern Scotland, were the ancient haunts of the Scottish bull. "Castle Dangerous," which Scott describes as among

the mountains which gave shelter to the wild bull, is not far off. These horned cattle, mixed with the local *Bos longifrons*, probably gave origin to the modern breed of cattle of that region.

It was in the late Duke of Buccleugh's knowledge that his favorite race of Galloways—of which he was the champion—was, up to the middle of last century, a horned race; and he, true conservative, deplored the change. Perhaps the change had been wrought in a similar manner to that of the Ardrossan herd; or by some influence of the territorial magnates on their acquirement by political means of a connection with a country containing among its wild cattle many of the polled variety.

The climate of Galloway region is described by writers on the breed, explaining thus the coarse hair that is a characteristic of the Galloway, as very humid. And we see also the result of this humidity in the coarse horns of the historical breed.

Darwin quotes Prof. Low as to humidity of climate producing hair in abundance; and Youatt has also stated the correlation between coarse hair and horn. "We can thus see how a humid climate," says Darwin, "might act on the horns—in the first place directly on the skin and hair, and secondly by correlation on the horns." While the Galloway men themselves explain the finer coat of the Aberdeen from "*the drier*" climate.

And there is an absolute dearth of any collateral evidence, derivable from local literature, philology, sculpture, etc., to indicate the *non-existence* of horns in this ancient breed; the tradition, as will be shown, being that they were anciently universally horned.

Aberdeen-Angus Breed.

As the lowlands of the Caledonian region belong entirely to the counties associated with this breed, and as the breed from the earliest times was the same foundation, the maol Kyloe, the Hamilton polled, the dodded of the Meigle sculptured stones, the homyls of King Kenneth's time, and the hornless neat of T. Kirke, etc., must be accepted as the progenitors of this world-famous race of cattle. Formerly everything connected with the history of the breed was wrapped in obscurity—they being an unknown breed (to the outside world) in a *terra incognita*. I have in this investigation brought forward here what is new or of such importance as the subject required.

Investigators, in their researches into the history of this breed, have been chagrined to find in the first or second of the Surveys of the County of Aberdeen, drawn up for the Board of Agriculture, that no mention is made of any of the native breeds as being horn-

FIG. 1.—Skull (in possession of the author) of the imported Aberdeen Angus prize bull Justice (1462), 8 years old, died on the property of Judge J. S. Goodwin, Beloit, Kansas. Height of skull, 20 inches. (From a photograph.)

less. This, now, is regarded as remarkable, and more so for the reason that the author of the first Survey was a man of considerable repute, Dr. James Anderson. The first series of these surveys were, however, written chiefly from the strict agricultural point of view. The live-stock was undesignedly overlooked. So much, however, did this prove to be the case that a second series was

organized for the purpose of rectifying the mistake. There were about ten years between the two series.

The first Survey of the Agriculture of Aberdeenshire, by Dr. James Anderson, of Monkshill, in the Buchan district, was published in 1794. The author never mentions *horn* or *hornless* in describing the two breeds that come in for notice. One of these can, however, be identified with the old long-horned Aberdeenshire breed, described as being fine and rich milkers; the other, mentioned as the cattle of Buchan, which can be identified by the evidence of his own household as the native low-country polled Buchan. He gives good general testimony to the high character of the latter.

James Anderson, LL.D., was born near Edinburgh, 1730; died in London, 1808. He farmed extensively in the Buchan district of Aberdeenshire. He was a voluminous writer, and is thus referred to by Darwin ("Variations of Animals and Plants," second edition, Vol. I.): "Another ingenious writer, though not a naturalist, with a bold defiance of everything known on geographical distribution, infers that the sheep of Great Britain alone were the descendants of eleven endemic British forms!" Yet he was quoted largely by others. Having resided so long in Buchan, it seemed incredible that such a man, such a ready observer, even though not a naturalist, should have escaped noticing, in some way, the special peculiarity—as hornlessness was apparently to him—of the cattle of that region, named, indeed, from that peculiarity itself, Buchan *Humlies*, from time immemorial. So it appeared to the general student. But, for the reasons mentioned, it appeared to me that he must have made some such allusion. So I carefully examined all his works likely to contain anything of the nature sought. In his "Recreations in Agriculture and Natural History, etc.," completed in six volumes, I find him descanting thus (p. 67, Vol. I., published 1799, "On Varieties of Animals: an enquiry into the nature of that department of Natural History which is called Varieties among Animals, etc., with some cursory hints upon the same term as applied to Vegetables"): "If a chance individual be produced that is of a large size, or particular make of body, the descendants of that individual, if mated with one having similar peculiarities, will be of the same kind. The same thing will happen if it have a

tendency to fatten more kindly, to yield a greater or smaller quantity of milk, to lay fat on a particular part of the body, to produce more or less tallow, to be more or less hardy, or any other peculiarity. Even accidental blemishes may thus be perpetuated. If a hornless individual be born of a hornless breed of creatures,[1] this may give rise to a whole tribe of hornless beasts of that kind, which will propagate their like with as little deviation as takes place in the original stock. If a kind of creature that usually carries two horns chance to produce one with three, four, or six horns, you may thus obtain a breed having many horns. Thus we are able to account for those families or breeds of domestic animals which differ in regard to certain particulars of the kind above specified, and which, when once introduced [or appearing] into a certain district, have a tendency to continue themselves in that district for a great length of time if considerable pains be not taken to alter it. The means of altering such a breed are, however, from the facts here stated, clear and obvious; nor can it be effected with certainty but by a change of blood, or an intermixture of breeds. If the qualities of the peculiar breed are excellent, the means of improving it are equally obvious, the selecting of the best individual of that breed, and which have the wished-for qualities in a higher degree than the ordinary, to breed from; and, if they be done with ease and judgment, its effect will be certain and by no means liable to any kind of doubt." The reference in the Index to the above passage is: "Hornless breeds of cattle, how produced." The above affords a good deal. In the first place Dr. Anderson regarded cattle without horns a *blemish.* This would prove that he was unacquainted with any other polled breeds, if such there were, in Scotland. If he had, he would not have been able to regard it as a blemish. Secondly, that these polled creatures had *continued in that district for a great length of time*, and had occurred indigenously previously to his advent in the country at any rate, which would take us back to the beginning of the century (1700).

[1] I would direct attention to the use of this word *creatures*, which sounds so peculiar to an old country man, and to the new comer to this country, for I found it used pronounced "*critturs*" to describe cattle. Thus in America the original usage of the word is maintained, like so many others. Indeed, as I show, from the Index reference, Dr. Anderson uses the word, also, to describe cattle.

Thirdly, he was one of a number (it will be seen, from the means he recommended, at that early date, to eradicate a blemish) who were doing their best to obliterate the old native polled race of such a good quality. He was isolated in Buchan, with only the Buchan Polled breed before his eyes, surprised at the want of the horns he found there to be indigenous, and thus attempted to explain an "isolated" instance, as he thought it; whereas, if he had had a wider acquaintance with the innumerable polled races that had existed in all time, he would have attempted some more scientific explanation—one which I may say here, remembering Darwin's allusion to him, has escaped or baffled that prince of naturalists himself.

But the "hornless breed of Buchan creatures" survived the attempt made to obliterate the blemish which had existed for such a length of time, up till 1799, and which had now been setting the fashion for all breeds. Dr. Anderson's overseer, who began to deal in 1801, has recorded the existence of polled cattle in Buchan during Dr. Anderson's time, and since then they have become the most famous of polled races.

Now I have brought Dr. Anderson into line, and made him yield testimony to the early existence of the polled cattle of Aberdeenshire, which is about the most important piece of evidence that has been produced on this subject, and is most interesting.

The Galloway Breed.

Up to about the beginning of the last quarter of last century the Galloway cattle were horned, and during the middle of that century were "universally" so. The earliest certain account of them as polled is given by Marshall, who wrote in 1782. He says that *the best* were at that date mostly polled. Andrew Wight, in 1746, mentions them more promiscuously.

The late Sir B. T. Brandreth Gibbs, Hon. Secretary of the Smithfield Club, etc., etc., as General Superintendent of the British Agricultural Section of the Paris Universal Exhibition of 1878, in the "Short Introductory Notes on Some of the Principal Breeds of Cattle, Sheep and Pigs," written by him and prefixed to the Catalogue of the British Section, says: "Occasionally some have small 'slugs' or stumps, which are not affixed to the skull." Dr. Flem-

ing, 1812, wrote similarly about the existence of these "slugs" then, and is quoted by Boyd-Dawkins as evidence of the *last appearances* in this ancient breed of a reminiscence of its former character. But Youatt *twenty years later* notices them, and in 1878 Sir B. T. Gibbs also. The above facts are of scientific interest, showing the transformation of an ancient race from the horned to polled state. Professor Boyd-Dawkins has likewise favored me with the following notes :—

"The only historical account of the origin of the British polled cattle with which I am acquainted is in the letter of the late Lord Selkirk to which you allude. Lord Selkirk was a man of remarkable ability, and one of the best of the Scotch lairds, and is not likely to have made any important slip. I have no doubt that his account of the breeding out of the horns is substantially accurate, so far as relates to the Galloway cattle. Moreover, on referring to Youatt, p. 155, I find incidental evidence that Lord Selkirk is right."

"Oral testimony," says Mr. David McCrae, author of a history of Galloway cattle, "handed down to these men from the Galloway breeders of last century, is valuable and reliable." So the letter from the late Earl of Selkirk, F.R.S., written to Prof. Boyd-Dawkins is of particular value. Boyd-Dawkins in introducing it says: "The polled or hornless cattle of the present day have undoubtedly been derived, through careful breeding, of the horned cattle. The Galloway breed has lost its horns principally through the care of the grandfather of the present Earl of Selkirk, to whom I am indebted for the account given in full below. Some fifty or sixty years were consumed in bringing this animal to its present shape and form." The letter is as follows; it is dated March 6, 1867 :—

"I have no distinct written record about the way the horns of the Galloway cattle were 'bred out,' as we cattle-breeders say. The breed 150 years ago was not generally polled, *i.e.*, without horns, though there was always a good many polled ones amongst them. Polled ones are found in every breed. My informant was an old man who died about thirty years ago, he being then nearly ninety. He was the son of the man who tended the cows of my grandfather, and had been employed among cattle all his life; in his old age, while still able to work, he tended my cows. His

name was James McKinnan, and he was a man whose recollections seemed always remarkably clear. He had been with cattle as far as Norfolk, to St. Faith's fair; he told me that in the days of his childhood, a Norfolk feeder, who bought many of the Galloway cattle, fancied those without horns, and would give 2*s.* 6*d.* or so more for a polled than a horned beast. This set the fashion, and the people began first to look for polled bulls, and none other; then they preferred polled cows, etc., to breed from, and thus the change was effected in, I believe from fifty to sixty years. The horns of the Galloway beast were very ugly, drooping, and as thick at the point as at the root. I have myself seen one or two beasts with horns like that; but nowadays, when horns appear they are generally traced to some with a cross with the Irish breed. Those that are born polled have a lump in the centre of the forehead, which is very hard, and will break another bull's skull for him."

FIG. 2.—"Galloway Heifer exhibited at Lord Somerville's cattle show, 1806."—From the *Complete Grazier*, 1816,

The late R. Gibson, Assistant Curator of the Museum of Science and Art, Edinburgh, Scotland, in the article "Cattle," in the last edition of "Encyclopædia Britannica," arranges British cattle into three classes: "(1) Polled cattle, an artificial variety, which may be produced by selection; thus, the polled cattle of Galloway had small horns so late as the middle of last century, but by only breeding from bulls with shortest horns, the grandfather of the present Earl of Selkirk succeeded in entirely removing these appendages." Gibson was arguing from the history of only one instance.

Aiton, in his Survey of Ayrshire, 1813, says: "According to tradition, the Galloway cows were, in ancient times, uniformly provided with horns."

There were numerous introductions of foreign blood into Galloway; to give an instance: "Admiral Keith Stewart lately introduced [into Galloway] a beautiful Argyllshire bull, which he considered to have made the greatest improvement of any on the country breed" (Agr. Rep. of Galloway, p. 22). That does not look as if the breed was polled. And Aiton says, "Stories were told of bulls being brought from England—north and west—which banished their [the Galloways'] horns for them." Some also think that it was on the introduction of the Irish *moyl* that the polled character dates. As Gilbert shows, there was a continuous interchange of cattle between the border counties of England and Scotland. And, as shown by Storer, Low, and the early historians, and ourselves, the tendency of cattle was continually from the north of Scotland to the south, and not *vice versa.* So that it is difficult to trace a straight line descent for the Galloway, as can be done for the Aberdeen-Angus, whose country was never so invaded. The latter were the real ranche cattle of early Britain, and were the first to open up the highways from the north to the south.

The Norfolk and Suffolk Red Polled Breed.

This East Anglian breed of polled cattle is an amalgamation between the "old Norfolk" horned race and the "old Suffolk" polled. The latter could hardly escape having "acquired its hornless character from contact with the white variety maintained at some of the old establishments in the district," *i.e.*, the herds of polled cattle in the parks already described. It was not till 1846 that there had been such an amalgamation between the old Suffolk with the old Norfolk as to entitle the two varieties to be recognized as one breed. There is in the lobby at Raynham Hall a picture of Starling, a cow of the old Norfolk breed, in the thirty-sixth year of her age, which preserves to us the apparent character of this old breed.

Mr. R. E. Lofft gives the following account of the evolution of this race:—

"The origin of the present breed of Red Polls is perfectly well known. About a hundred years ago the native cow of Norfolk, a variety peculiar to the county, of a red color, with a white face, and horned, was crossed with the Suffolk polled bull, with a view,

mainly, no doubt, to improve the milking qualities of the breed, as well as to do away with the horns. Since then this old Norfolk breed seems to have died out. But the old Suffolk breed survives pure in one peculiar variety—a cow of golden yellow. Of course there are various shades of this color, but the real golden yellow is, to my mind, the most beautiful of all colors; it is sometimes seen in horses, though but very rarely. Indeed, I do not recollect to have seen more than three or four in the course of my life. However, this color is not popular in cows of the Red Polled breed, nor, indeed, I believe, among Short-horns. Perhaps the reason for this is that a pale washed-out yellow, which often occurs, gives a feeble look to an animal.

"Of the old Suffolk breed, no one pretends to have traced the origin. Perhaps, in some future day, some of the numerous old manuscripts that are being reproduced in print may throw some light on the history of this animal—at present it is purely conjectural. The balance of probability would point to this kind of cattle being derived from the old white breed with black or red ears and muzzles. Polled cattle of this description were formerly to be found in various parts of Suffolk and Norfolk, and some small remnants remain to this day. The transition from white to yellow would not appear to be difficult. The pictures of J. Ward, the eminent cattle and landscape painter, furnish numerous instances of the prevalence of this breed, both polled and horned varieties, whether from an artistic preference, or from an actual preponderance of the type, it is hard to say. I have, myself, two oil paintings by this master, one of which contains a polled and the other a horned cow of the white breed, with red muzzle and ears. The breed with black ears and muzzles and more striking in appearance from the strong contrast in color; indeed, it is hardly possible to find anything prettier than a young calf of this kind. In the National Gallery there is a large landscape of a Yorkshire scaur, with groups of cattle. In the foreground stands a white bull of very massive proportions, ears and muzzle being of a light red.

"The earliest descriptions of Suffolk cattle speak of them as of various colors, some cream or yellow, some brindled; others, again, as red; some as mouse-colored, or a kind of blue, but none of them as black—in this respect differing from the Scotch Kyloes, one of

the oldest, if not the oldest, breed of cattle in the British Isles. It is certainly not a little peculiar that none of the writers of that day mention black Suffolks, more especially as some of the Suffolks had been crossed with Galloways—a breed in which black certainly predominates. No doubt, at times, red Galloways have been produced from pure-bred black parents, and some were said by Youatt to be of a dun or drab color. However, I am not inclined to accept the evidence of color as a sign of purity of race."

Mr. Youatt has given it as his opinion that the Red Polls are descended from the Galloway breed; but after a careful and impartial examination of the records bearing on the subject we are inclined to believe with Mr. Euren, editor of the Herd-book, that in the several varieties of Red Polled cattle we have the descendants of the ancient breed valued by our ancestors for their large yield of milk. This explanation of the derivation of the breed is the more probable when it is remembered that since 1765 there have been domesticated herds of white polled park cattle in Norfolk, they having in that year been taken to Gunton, in Norfolk, from Middleton Hall, where they were maintained in a wild state long prior to 1697. These Gunton polled cattle and their offshoots became domesticated in Norfolk, were multiplied in the county, and it is almost certain that to them is chiefly due the distribution of a polled breed over the county. Arthur Young, in his survey of Suffolk, dated 1792, remarks that the cattle there "were universally polled—that is, without horns." Files of the *Norfolk Mercury* show that in 1774 there were whole dairies of polled cattle in the county. It is clear that the Galloway cross was also introduced; but there is distinct proof that polled cattle existed in considerable numbers both in Norfolk and Suffolk prior to the date when the Galloways themselves became generally polled.

We read in the *Norwich Mercury* of 1770 advertisements of polled cattle, both bulls and cows, to be sold near Cawstown, Peepham and Pullham market. In 1802, advertisements for the Red Polled cattle were very numerous.

These Galloways are distinctly stated to have been for purposes of feeding, simply; and that they were not used for creating a hornless variety out of already hornless cattle is evident from the total want of similarity between them, not only in color but general

resemblance. The two breeds are totally dissimilar. If there is any resemblance in general contour and appearance between the Suffolk and Scotch Poll, it is to the Aberdeen-Angus, and not the Galloway. Photographs or engravings of these two breeds are strangely similar, and might be taken for either breed, except, in reality, the color and size; while pictures of Red Polls and Galloways could be distinguished at a glance. As Mr. R. E. Loftt points out, in a letter he has favored me with, "black and red are convertible colors, red Galloways being every now and then produced from pure-bred black sire and dam." But whoever heard of a *black* Suffolk polled cow?—which would be bound to appear once in a while if the breed owed any origin to a black polled breed. So that "an investigation of even a very limited nature is sufficient to convince any one that the theory has been properly exploded," "that a breed of cattle, themselves hornless from their earliest origin, needed a cross with another hornless breed in order to make them polled."

I have carefully examined all the earliest authorities on the counties of Norfolk and Suffolk that could be expected to throw light on this subject. These authorities are: *Norfolk*—Nathaniel Kent, "General View of Norfolk," 1794; William Marshall, "Rural Economy of Norfolk," 1787; Arthur Young, 1804. *Suffolk*—Arthur Young, "General View of Agriculture of Suffolk," 1794; and the following: Culley, "On Live Stock"; John Lawrence, "Cattle," 1805; and Richard Parkinson, "Live Stock," 1810. The particulars given by these authorities need not be repeated here. Suffice it to say—as these notes are only required to go so far as will establish the correct origin of the polled breeds—in none of these county reports is there any evidence to support the assertion that the Red Polls owed any origin to the Galloway Scot; in fact, "no allegation had ever been made in such well-informed quarters" to such effect. Culley appears to have been the genius who "discovered" this supposititious origin for a breed already polled, and Lawrence, Parkinson, Henderson, Youatt and others have been content to serve up the same old fable without examination—thus leaving a legacy of error to the Galloway historian, to his own detriment.

As to the claims of the Galloway, therefore, as being the origin

even in part of the Suffolk, or any other polled race which were polled before they were, the position may be illustrated thus: To the name given to a certain garden weed, coltsfoot, whose flower appears before the leaves, hence called "the son before the father." To the ideas expressed in the Rig-veda.[1] Indra is the principal god of the Veda, who made Heaven and Earth, and the account of whose origin is that he had "begotten his own father and mother from his own body." "Indra begat his parents" is exactly the parallel of the claims of the Galloway.

The above may be said to be all that is known at present in the best-informed quarters. I now am able to produce the last and most conclusive item of testimony to this already well-forged chain. This is derived from the "palæontology" of language; by the existence, in the good old times, of a word used in Suffolk to name the polled cattle of the locality. That word was *mooly*, meaning *a polled cow*. It was in use, according to old English philologists, during and previous to 1750, as will be shown in the chapter on Philology. This will illustrate the value of philology as a source of evidence. It occupies a similar and as exact a position as "the testimony of the rocks." That the word was of Suffolk use in England and was a household word in those days is incontestible. It is therefore curious to know that it seems extinct now, or unknown to such a widely informed student as Mr. G. Gilbert, for in answer to my query he informed me he was totally unaware of any local or provincial word used in the way indicated. The very near equivalents of the word, as in the Irish and Gaelic *maol*, and north of Scotland *mooly*, will be commented on again, and they suggest important reflections.

The fact of the use of this word in these days in Suffolk is proof sufficient of the great antiquity of the cattle the word described—an antiquity much greater than of a breed that never had any such cognomen—as the Galloway.

But I offer another proof of the worth of this link of evidence as satisfying our requirements in that respect. Let us jump over to America. What do we find? That this same word *mooly* is in

[1] The Cosmology of the Rig-veda. By H. W. Wallis. Published by the Hibbert Trustees. Williams and Norgate, London.

India, What does it Teach us? By Max Müller. Funk and Wagnalls.

universal, living, use to describe the polled cow in all her various forms.

Mr. Euren, in his history of the breed in the Red Polled Herd Book, Vol. I., very evidently was perfectly unconscious of the fact of the claims of the word *mooly* to being an early Suffolk provincialism. If he had, how more positive would have been the remarkable query he makes—showing how close his "speculation" came to real exactitude;—note he uses marks indicating the "foreign" use of the word: "'Muley' cattle have been in Virginia for a great many years, and their descendants have also been uniformly polled. . . . It would be of value to the students of the history of cattle were search to be made respecting the introduction of polled stock into America. It is recorded that many of the earlier settlers were natives of Norfolk and Suffolk villages. May they not have taken over polled cattle, which at that day were so numerous in Suffolk and on the Norfolk borders?"

He does not suggest that these settlers, if they did not—the first of them—take polled cattle, took the word *mooly* with them; and, finding that the cattle there, of various origins, then or subsequently introduced, frequently coming polled, applied the word to them they had been accustomed to.

HISTORY OF GARDEN VEGETABLES.

BY E. LEWIS STURTEVANT, M.D.

(Continued from page 433.)

Ice Plant. *Mesembryanthemum crystallinum* L.

THE ice plant, from the Cape of Good Hope, was introduced into Europe in 1727.[1] It is advertised in American seed lists[2] of 1881 as a desirable vegetable for boiling like spinage, or for garnishing. Vilmorin[3] says the thickness and slightly acid

[1] Noisette. Man., 1829, 538.
[2] Thorburn's Cat., 1881.
[3] Vilmorin. The Veg. Gard., 1885, 275.

flavor of the fleshy parts of the leaves have caused it to be used as a fresh table vegetable for summer use in warm, dry countries. It is, however, he adds, not without merit as an ornamental plant.

It is called in France *ficoide glaciale, glaciale;* in Germany, *sis-kraut;* in Flanders and Holland, *ijsplant, ijskruid;* in Italy, *erba diacciola;* in Spain, *escarchosa, escarcha.*[1]

Italian Corn Salad. *Valerianella eriocarpa* Desv.

This species occurs in gardens in two varieties. It has a lighter green, somewhat longer leaf than the ordinary corn salad, slightly hairy and a little dentate on the borders towards the base.[2] It has the same uses. It is described for American gardens in 1863.[3] Under its common name *grosse mache* it is noticed in France in 1829, and also as *mache d'Italie* in 1824.[4]

Called in France *mache d'Italie, regence, grosse mache;* in Germany, *italienischer ackersalat;* in Holland, *italiansche koornsalad.*

Valeriana coronata Willd. is occasionally grown abroad as a salad plant under the name of Italian corn salad.

Jerusalem Artichoke. *Helianthus tuberosus* L.

This plant was cultivated by the Huron Indians,[5] and was in use by the New England Indians at an early period.[6] It reached Europe in the early part of the seventeenth century, as it is not mentioned in Bauhin's Phytopinax, 1596, and is mentioned in his Pinax, 1623, where, among other names, he calls it "Chrysanthemum e Canada quibusdam, Canada & Artichoki sub terra, aliis." It is figured by Columna[7] in 1616, and also by Laurembergius[4] in 1632, and Ray,[8] 1686, is the first use I have found of the name Jerusalem artichoke, but Parkinson uses the word in 1640, according to Gray. In 1727 Townsend[9] says it "is a Root fit to be eat

[1] Vilmorin. Les Pl. Pot., 1883, 218.
[2] Vilmorin. Les Pl. Pot., 1883, 325.
[3] Burr. Field and Gard. Veg., 340.
[4] Noisette. Man., 1829; L'Hort. Fran., 1824.
[5] Asa Gray. Am. Agric., 1877, 142.
[6] Pickering. Ch. Hist., 749.
[7] Columna. Minus cognit. stirp. pars altera, 1616, 13.
[8] Laurembergius. Apparat. Plant., 1632, 131.
[9] Townsend, seedsman, 1726, 23.

about Christmas when it is boil'd"; Mawe,[1] in 1778, says it is by many esteemed; Bryant,[2] in 1783, says, "not much cultivated." In 1806 McMahon[3] speaks of it in American gardens, and calls it "a wholesome, palatable food." In 1863 Burr[4] describes varieties with white, purple, red and yellow-skinned tubers.

The Jerusalem artichoke is called in France, *topinambour, artichaut du Canada, A. de Jerusalem, A. de terre, crompire, poire de terre soleil vivace, tertifle, topinamboux;* in Germany, *erdapfel, erdbirne;* in Flanders, *aardpeer;* in Denmark, *jordskokken;* in Italy, *girasole del Canada, tartufoli;* in Spain, *namara pataca;* in Portugal, *topinambor, batata carvalha;*[5] in Bengali, *bhramoka, soorjyamookhee.*[6]

The history of the Jerusalem artichoke has been well treated by Gray and Trumbull, in the *American Journal of Science,* May, 1877, and April, 1883. It was found in culture at the Lew Chew islands about 1853.[7]

We offer a synonymy as below:—

Flos Solis Farnesianus sive Aster Peruanus tubercosus. Col., 1616, 13.
Helianthemum indicum tuberosum. Bauh. pin., 1623, 277.
De Solis flore tuberoso, seu flore Farnesiano Fabii Columnæ. Aldinus, 1625, 91.
Battatas de Canada. Park. par., 1629, ex Gray.
Adenes Canadenses seu flos solis glandulosus. Lauremb., 1632, 132.
Flos Solis pyramidalis, parvo flore, tuberosa radice, Heliotropium indicum. Ger., 1633.
Peruanus solis flos ex Indiis tuberosus. Col. in Hern., 1651, 878, 881, ex Gray.
Potatoes of Canada. Coles, 1657, ex Phillips.
Canada & Artischokki sub terra. H. R. P., 1665, ex Gray.
Chrysanthemum latifolium Brasilianum. Bauh. prod., 1671, 70.
Chrysanthemum Canadense arumosum. Cat. H. L. B., 1672, ex Gray.
Helenium Canadense. Amman., 1676, ex Gray.
Chrysanthemum perenne majus fol, integris, americanum tuberum. Mor., 1630, ex Mill dict.
Jerusalem Artichoke. Ray, 1686, 335.

[1] Mawe. Gard., 1778.
[2] Bryant. 1783, 33.
[3] McMahon. Am. Gard. Cal., 1806.
[4] Burr. Field and Gard. Veg. of Am., 1863, 39.
[5] Vilmorin. Les Pl. Pot., 561.
[6] Perry's Jap., ii., 44.
[7] Birdwood. Veg. Prod. of Bomb., 165.

Corona solis parvo flore, tuberosa radice. Tourn., 1719, 489.
Helianthus radice tuberosa esculenta, Hierusalem Artichoke. Clayton, 1739, ex Gronov.
Helianthus foliis ovato cordatis triplinervus. Gronov. virg., 1762, 129.
Helianthus tuberosus. Linn. sp.. 1763, 1277.

Kale. *Brassica oleracea acephala* D C.

The kales represent an extremely variable class of vegetable, and have been under cultivation from a most remote period. What the varieties of cabbage were that were known to the ancient Greeks it seems impossible to determine in all cases, but we can hardly question but that some of them belonged to the kales. Many varieties were known to the Romans. Cato,[1] who lived about B. C. 201, describes the Brassicæ as: the *levis*, large, broad-leaved, large-stalked; the *crispa* or *apiacon;* the *lenis*, small-stalked, tender, but rather sharp-tasting. Pliny,[2] in the first century, describes the *Cumana*, with sessile leaf and open head; the *aricenum*, not excelled in height, the leaves numerous and thick; the *Pompeianum*, tall, the stalk thin at the base, thickening among the leaves; the *Brutiani*, with very large leaves, thin stalk, sharp savor; the *Sabellica*, admired for its curled leaves, whose thickness exceeds that of the stalk, of very sweet savor; the *Lacuturres*, very large headed, innumerable leaves, the head round, the leaves fleshy; the *Tritianon*, often a foot in diameter, and late in going to seed.

I have not sufficient knowledge to give a complete history of the kales. I can only review those races which I have had an opportunity of studying, and this I will make as short as possible, intending only to bring into form for further study.

I. The form of kale known in France as the *Chevalier* seems to have been the longest[3] known, and we may surmise that its names of *chou caulier* and *caulet* have reference to the period when the word *caulis*, a stalk, had a generic meaning applying to the cabbage race in general, and we may hence surmise that this was the common form in ancient times, in like manner as *coles* or *coleworts* in more modern times imply the cultivation of kales. This word *coles* or *caulis* is used in the generic sense, for illustration, by Cato,

[1] Cato. Script. Rei Rust., 1787, vol. i., p. 75.
[2] Pliny. Lib. xix., c. 41 ; Lib. xx., c. 33.
[3] A. P. Decandolle. Mem. on the Brassicæ, 1821, 7.

two hundred years B. C.; by Varro and Æmilius Macer in the first century B. C.; by Columella the first century A. D.; by Palladius in the third; by Vegetius in the fourth century A. D.; Albertus Magnus in the thirteenth, etc. This race of the Chevaliers may be quite reasonably supposed to be the *levis* of Cato, sometimes called *caulodem*,[2] of no medicinal use.

·According to Decandolle,[3] this race of Chevaliers has five principal sub-races, of which the following is an incomplete synonymy:—

I.

Brassica lævis. Cam. epit., 1586, 248; Matth. op., 1598, 366.
Br. vulgaris sativa. Ger., 1597, 244.
Cavalier branchu. Decand. mem., 1821, 9.
Thousand-headed. Burr, 1863, 236.
Chou branchu du Poitou. Vilm., 1883, 135.
Chou mille tetes. Vilm. l. c.

II. a. viridis.

Kol. Roszlin, 1550, 87.
Brassica. Tragus, 1552, 720.
Brassica alba vulgaris. J. Bauh., 1651, ii., 829.
Chou vert commun. Decand. mem., 1821, 9.
Cow Cabbage. Burr, 1863, 232.
Chou cavalier. Vilm., 1883, 134.
Brassica vulgaris alba. Chabr., 1677, 290.

II. b. rubra.

Brassica primum genus. Fuch., 1542, 413.
Br. rubra prima species. Lugd., 1587, 523.
Br. rubra. Ger., 1597, 244.
Br. rubra vulgaris. J. Baughin, 1651, ii., 831; Charb., 1877. 270.
Red cavalier. Decand. mem., 1821, 9.
Flanders kale. Burr, 1863, 233.
Caulet de Flander. Vilm., 1883, 134.

III.

Brassica vulgaris sativa. Lob. obs., 1576, 122; ic., 1591, i., 243; Dod., 1616, 621.
Br. alba vulgaris. Lugd., 1587, 520.
Brassica. Cast. Dur., 1817, 76.
Chou a fevilles de Chene. Decand. mem., 1821, 10.
Buda kale. Vilm., 1885, 141.

IV. a.

Brassica secundum genus. Fuch., 1542, 414.
Br. fimbriata. Lob. obs., 1576, 124; ic., 1591, 247.

Br. sativa crispa. Ger., 1597, 244.
Br. crispa. Dod., 1616, 622.
Br. crispa lacinosa. J. Bauh., 1651, ii., 832.
Chou vert frise. Decand. mem., 1821, 10.
Tall Green Curled. Bnrr, 1863, 236.
Chou frise vert grand. Vil., 1883, 131.

IV. b.

Brassica crispa, seu apiana. Trag., 1552, 721.
Br. crispa Tragi. Lugd., 1587, 524.
Br. tenuifolia laciniata. Lob. ic., 1591, i., 246.
Br. selenoides. Dod., 1616, 622.
Br. tenuissima laciniata. J. Bauh., 1651, ii., 832.
Br. selenoides. Ger., 1597, 248.
Chou plume or Chou aigrette. Decand. mem., 1821, 11.
Ornamental kales of our gardens.

V.

Brassica tophosa. Ger., 1547, 246; J. Bauh., 1651, ii., 830.
Br. tophosa Tabernemontano. Chabr., 1677, 270.
Chou palmier. Decand. mem., 1821, 11; Vilm., 1883, 133.

These forms occur in many varieties, differing in degree only, and of various colors, even variegated. In addition to the above we may mention the proliferous kales, which also occur in several varieties. The following synonyms refer to proliferation only, as the plants in other respects are not resembling:—

Brassica asparagoides Dalechampii. Lugd., 1587, 522.
Brassica prolifera. Ger., 1597, 245.
Brassica prolifera crispa. Ger., 1597, 245.
Cockscomb kale. Burr, 1863, 232.
Chou frise prolifere. Vilm., 1883, 133.

II. *The Dwarf Kales.*—Decandolle does not bring these into his classification as offering true types, and in this perhaps he is right. Yet olericulturally considered they are quite distinct. There are but few varieties. The best marked is the Dwarf Curled, the leaves falling over in a graceful curve and reaching the ground. It can be traced through variations and varieties to our first class, and hence it has been probably derived in recent times through a process of selection, or through the preservation of a natural variation. We have now an intermediate type between the Dwarf Curled and the Tall Curled forms in the intermediate Moss Curled.

III. *The Portugal Kales.*—We have two sorts of kales that have the extensive rib-system and the general aspect of the Portugal cabbage. These are the *Chou Brocoli* and the *chou frise de mosbach* of Vilmorin. I must consider these as bearing the same relation to the Portugal cabbage that our kales bear to the heading cabbages. Of their history I have ascertained nothing.

ON CERTAIN FACTORS OF EVOLUTION.[1]

BY ALPHEUS. S. PACKARD.

SO far as we are aware, Lamarck was the first naturalist to refer the atrophy of eyes and loss of vision to disuse from a life in darkness, as may be seen by the following extract from the chapter in his Philosophie Zoologique, entitled "De l'influence des circonstances sur les actions et les habitudes des animaux, et de celle des actions et des habitudes de ces corps vivans, comme causes qui modifient leur organisation et leurs parties." This work appeared in 1809, many years before the discovery of blind animals peculiar to caves.

"Des yeux à la tête sont le propre d'un grand nombre d'animaux divers, et font essentiellement partie du plan d'organisation des vertébrés. Déjà néanmoins la taupe, qui, par ses habitudes, fait très-peu d'usage de la vue, n'a que des yeux très-petits, et à peine apparens, parce qu'elle exerce très-peu cet organe.

"L'Aspalax d'Olivier (Voyage en Égypte et en Perse, II, pl. 28, fig. 2), qui vit sous terre comme la taupe, et qui vraisemblablement s'expose encore moins qu'elle à la lumière du jour, a totalement perdu l'usage de la vue; aussi n'offre-t-il plus que des vestiges de l'organe qui en est le siège; et encore ces vestiges sont tout-à-fait cachés sous la peau et sous quelques autres parties qui les recouvrent, et ne laissent plus le moindre accès à la lumière.

"Le protée, reptile aquatique, voisin des salamandres par ses rapports, et qui habite dans des cavités profondes et obscures qui

[1] From advance sheets of an essay on Cave Animals of North America. Mem. Nat. Acad. Sciences.

sont sous les eaux, n'a plus, comme l'Aspalax, que des vestiges de l'organe de la vue; vestiges qui sont couverts et cachés de la même manière.

"Voici une considération décisive, relativement à la question que j'agite actuellement.

"La lumière ne pénètre point partout; conséquemment, les animaux qui vivent habituellement dans les lieux où elle n'arrive pas, manquent d'occasion d'exercer l'organe de la vue, si la nature les en a munis. Or, les animaux qui font partie d'un plan d'organisation, dans lequel les yeux entrent nécessairement, en ont dû avoir dans leur origine. Cependant puisqui'on en trouve parmi eux qui sont privés de l'usage de cet organe, et qui n'en ont plus que des vestiges cachés et recouverts, il devient évident que l'appauvrissement et la disparition même de l'organe dont il s'agit sont des résultats, pour cet organe, d'un défaut constant d'exercice (2d edit., i, p. 241)."

In his "Origin of Species" Darwin, after claiming that "natural selection would constantly aid the effects of disuse" in the case of moles and the burrowing rodents, then remarks in regard to cave animals: "As it is difficult to imagine that eyes, though useless, could be in any way injurious to animals living in darkness, I attribute their loss wholly to disuse" (p. 142). On the next page he writes: "By the time an animal had reached, after numberless generations, the deepest recesses, disuse will on this view have more or less perfectly obliterated its eyes, and natural selection will often have effected other changes, such as an increase in the length of the antennæ or palpi, as a compensation for blindness."

It may be that the struggle for existence goes on even in the darkness of caves, and that the "fittest" of the limited population survive by reason of their adaptation to their untoward surroundings. How adverse to life of any sort caves are may be realized when we consider that only the lowest plants, and only a very few of those, live in caves. Without doubt the germs of fungi and the seeds of the higher plants are carried into the caves by freshets in subterranean streams and through sink-holes. Why, in spite of the darkness, we should not find more fungi even, and why one or two of the *green* algæ should not flourish in the pools and brooks of caves, or why the seeds of the higher plants should not germi-

nate, even if the plants do not bear fruit, can only be explained by the absence of light; and perhaps this is an important cause of the absence of all plant life in the ocean below a depth of about 300 to 500 fathoms. Certainly there are ample means for the colonization of caves by vegetables; the temperature, moisture, and inorganic food are more favorable than the sum total of conditions on alpine summits or in the high polar regions, or in hot springs.

Animal life can apparently withstand greater physical obstacles than vegetable. As regards the struggle for existence, it possibly exists to a limited extent in cave animals. There is probably not enough vegetable or decayed animal food for all the animals, and some may die of hunger. The carnivorous beetles and Arachnida perhaps have a less favorable chance to obtain living food than the Crustacea, for the blind crayfish have a tolerable abundance of food in the Cæcidotæa, perhaps the most abundant form found in caves containing underground waters.

We may, with Darwin, for convenience, use the phrase "natural selection" to express the process by which the cave fauna was produced, but such a term to our mind expresses rather the result of a series of causes than a *vera causa* in itself. There is of course no doubt but that many animals carried by different means into caves cannot thrive there, and consequently die. It is only those which have been able, by certain peculiarities of their life in the upper world allied to cave existence, to adapt themselves to cave conditions which permanently breed there. Such forms, it is convenient to say, have been by nature selected and are successful in colonizing the darkest and most forbidding and apparently hopeless corners in the earth's crust. But such a phrase as "natural selection," we repeat, does not to our mind definitely bring before us the actual working causes of the evolution of these cave organisms, and no one cause can apparently account for such a result. There is rather a complex assemblage of physical causes, all working together, to secure a harmonious result. The most important and potent of these causes, when we study them under such appreciable, because so extraordinary, conditions as the physical features of cave existence, would seem to be the following:

1. Change in environment from light, even partial, to twilight or total darkness, and involving diminution of food, and compensation for the loss of certain organs by the hypertrophy of others.

2. Disuse of certain organs.

3. Adaptation, enabling the more plastic forms to survive and perpetuate their stock.

4. Isolation, preventing intercrossing with out-of-door forms, thus insuring the permanency of the new varieties, species, or genera.

5. Heredity, operating to secure for the future the permanence of the newly originated forms as long as the physical conditions remain the same.

Natural selection perhaps expresses the total result of the working of these five factors rather than being an efficient cause in itself, or at least constitutes the last term in a series of causes. Hence Lamarckism in a modern form, or, as we have termed it, Neo-lamarckism, seems to us to be nearer the truth than Darwinism proper or "natural selection."

The factors of organic evolution such as we have mentioned are, of course, theoretical, and the critic or unbeliever in a theory of descent demands facts in demonstration of the truth of the derivation of cave animals. Of the facts we have ourselves observed, or which have been observed by others, we will briefly summarize:—

1. The variations in *Pseudotremia cavernarum* and *Tomocerus plumbeus,* found living near the entrance of caves in partial daylight.

2. The bleaching of Polydesmus and Machilis found living in small caves; the blindness of Neotoma, or the wood-rat of Mammoth Cave; of fish found in wells and subterranean streams; the atrophy of the mole's optic nerves induced in one generation.

3. The larger size of the eyes of the young than in the adult Troglocaris of Europe, and the blind crayfish of American caves; Semper's history of the atrophy of eyes in the parasitic Pinnotheres; eyes of *Gammarus pulex* affected after living in darkness; the eyes of Gammaridæ in Lake Baikal becoming smaller the deeper they live; the instability in the eyes of Cæcidotæa.

In a small cave near White's Cave, and at a point about sixty feet from the mouth, occurred a salamander (*Spelerpes longicaudatus* Green), which was apparently bleached, being nearly white, with dark brown blotches. The common *Cambarus bartonii* occurs somewhat bleached in Mammoth Cave, and this may not be the result

of inheritance, but occurs in young hatched without the cave, and afterwards carried in so as not to be exposed to the light, the shell remaining pale as in the very young. Perfectly white, bleached specimens of the common *Polydesmus granulatus* Say, occurred in Indian Cave. The pale variety of *Tomocerus plumbeus* is possibly the product of a single or at least very few generations; the white and blind Porcellio found by Mr. Hubbard in Little Wyandotte Cave, though possibly a true cave form, has not yet been found elsewhere, and may have been the young of a normal, epigean species. But the most striking instance is the bleached specimen of *Asellus communis* from Lost River, referred to on pp. 15 and 33, which, though white, had eyes of normal size: there is good reason to suppose that these specimens were hatched in epigean waters, and that being carried into Lost River when young, the pigment in its skin, owing to absence of light, had failed to assume its normal dark color.

A parallel case is that mentioned by R. Schneider[1]:—

"The author gives an account of the subterranean variety of *Gammarus pulex* which is found at Clausthal. The first point of interest is its pale color, pigment being so completely absent from its body that it is milk-white and transparent; even the fat-cells, which are intensely red or orange-yellow in the ordinary *G. pulex*, are quite white. In the second place, the eye is not normally developed, but is in the first stage of reduction; the crystalline cones show signs of degeneration, and the whole eye exhibits that 'megalophthalmy,' or proportionately greater size which is often the first indication of loss. The pigment has also begun to be reduced, and is of a dirty black, instead of a brownish color. The anterior pair of antennæ exhibits elongation, owing to the increase in the number of the joints.

"There is, as compared with the ordinary forms, a considerable increase in the amount of calcareous deposits; and there is always a considerable amount of iron-oxide in the contents of the intestine, whence the iron makes its way to various parts of the body.

"Fries[2] suggests that experiments should be made on the effects

[1] Unterirdische Gammarus von Clausthal, P. B. Ak. Berlin, 1885, p. 1087; also, Abh. z. Programm k. Real-Gymnasiums Berlin, Ostern; Abstr. in Journal Roy. Micr. Soc. (2), vi., p. 243.

[2] Zool. Anzeiger, Aug., 1879, pp. 36, 37.

of rearing normal, eyed Gammari in darkness, and refers to Humbert's statement that in the greater depths of Lake Baikal, with an increase in depth of their habitat, there is an increasing lack of development of the eyes in some Gammaridæ. Fries also states that he himself had previously observed a decrease in the pigment of the eyes in young examples of *Gammarus pulex* living in darkness."

Here should be cited the observations of Anton Stecker, who states that Chermes, usually said to be eyeless, has rudimentary eyes, represented by clear, somewhat transparent spots, the chitin forming them being devoid of the granulations covering the rest of the shield.

"Each cornea is supplied by a large and well-developed optic nerve, proceeding from an optic ganglion in connection with the brain. But the layer of crystalline rods was wholly absent. About 30 to 35 per cent. of the specimens of *Chermes cimicoides* examined possessed these eye-spots; in the remaining 65 to 70 per cent. they were absent, as well as the optic nerves; while there was only one, or even no recognizable rudiment of an optic ganglion. He also found that the offspring of parents, both of which had eyes, were themselves provided with them; but that if either the father or the mother were blind, the young were also blind, having at most a feeble indication of optic lobes. Dr. Stecker considers this a most instructive case of the gradual atrophy of an organ by disuse owing to the influence of changed conditions. There can be little doubt that the ancestors of Chermes possessed well-developed eyes; the first steps in the retrogressive process was the loss of the cornea and cones, the optic nerve and ganglion remaining after the true percipient apparatus had gone."[1]

Here is a fertile field for careful and long-continued observations on animals reared in different degrees of darkness. Such experiments will afford a crucial test of the theory of rapid evolution of genera and species due to sudden changes in the environment.

It is evident that physiological experiments are needed as well as embryological studies, to throw further light on the origin of cave animals. The blind-fish, blind crayfish, and Cæcidotæa,

[1] Morp. Jahrbuch, iv., 279, 1878; Journ. Roy. Micr. Soc., ii., 146, 1879.

which might be reared in dark cellars, should be observed for a series of generations, to ascertain whether by breeding the eyes cannot be restored, and the species by artificial means be induced to revert to its ancestral type. The embryology of the cave beetles, with or without rudimentary eyes, of the eyeless spiders and of Myriapods, of the Cæcidotæa, and of the blind crayfish and blindfish should be carefully worked out as regards the presence of organs of vision in a rudimentary state, though we should hardly expect to find rudimentary eyes in Anophthalmus when larva and pupa do not possess them.

Isolation as a Factor in the Origin of Cave Animals.—When any cave, such as Mammoth or Wyandotte, etc., is once colonized by emigrants from the upper world, and the colonists becoming adapted to the new conditions environing them, have lost their eye-sight, or even all traces of eyes, and the new forms thus established begin to breed true to their recently acquired characteristics, it is obvious that this process of in-and-in breeding will continue as long as the new forms live in total darkness and are isolated from the allied forms or their eyed ancestors of the upper world of light. Though a subordinate factor, isolation is certainly of no little importance in securing the stability of the new species and genera. It is evident that if no stragglers from the upper world, as species of Trechus to interbreed with the cave Anophthalmi, species of Choleva to cross with Adelops or Bathyscia, or species of Ceuthophilus to mix with the true cave Ceuthophili, or species of Myriapods or Arachnida to intercross with the cave forms, then the latter will tend to remain as fixed as we now find them to be. In the case of the crayfish of Mammoth Cave, the normal *Cambarus bartonii*, introduced at times of heavy rains or freshets into the cave, is not seldom found living in company with *Orconectes pellucidus*, the blind form, but belonging to a different section of the genus as regards the shape of its gonopods or first male abdominal appendages, and being of much larger size, it is probably incapable of fertilizing the eggs of the blind form, even if the latter, timid and sensitive to the least disturbance of the water, should allow itself to be approached by the larger-eyed form. It is also probable that *Cæcidotæa stygia* is seldom, if ever, brought in contact with *Asellus communis*, which abounds in the pools and streams through-

out the cave region. I have never found a stray Asellus even partly bleached and with diminished eyes in any caves, nor seen such specimens in collections made by others, though they may yet be found. Whether living in caves or wells fed by subterranean streams, the bleached, eyeless, or nearly eyeless, forms breed true to their type, and show no signs of intercrossing with lucophilous forms.

Should, however, these cave forms be placed in such circumstances as to be able to mix or intercross with their epigæan allies, which are in all probability the very species to which they owe their origin, there would with little doubt be a constant tendency to revert to the ancestral eyed forms, and we should constantly find certain individuals with visual organs better developed, and with a darker integument, serving as connecting links. Such links may have been common enough when the caves were first formed and colonized, and in some species, as *Pseudotremia cavernarum,* they frequently occur at the present time, but, as a rule, owing to long isolation or seclusion, and the consequent impossibility of intercrossing, they are now rare.

But as circumstances are now, the total darkness, the temperature, the degree of dryness or the moisture, and other physical conditions remaining the same, the cave fauna is almost completely isolated from that of the upper world; indeed, far more so than the deep-sea fauna of the ocean or of lakes, or the faunas of deserts or of the polar regions, or the alpine inhabitants of lofty mountain summits. We thus realize that isolation may be a not unimportant factor in securing permanence of type, after the typical characters have once been established through adaptation and heredity.

After reflecting upon the influence of isolation upon cave animals as securing permanence of varietal, specific, and generic characters, one is led to realize as never before the importance of geographical isolation in general as a factor in preventing variation after the organisms have once become adapted to their peculiar environment, whether dependent on temperature, soil, humidity, or dryness, the absence of light, or any other appreciable characteristic in their surroundings. We know also that the existing desert, deep-sea, and polar faunas are the product of Quaternary times; that they were nearly contemporaneous in origin with the cave faunæ,

though the deep-sea faunæ may date from the cretaceous period. Finally, I may quote from Darwin's "Origin of Species" the following extract, which applies (though he did not make it applicable to any special case) with peculiar force to cave fauna: "If, however, an isolated area be very small, either from being surrounded by barriers, or from having very peculiar physical conditions, the total number of the inhabitants will be small, and this will retard the production of new species through natural selection, by decreasing the chances of the appearance of favorable individual differences" (Fifth edition, New York, p. 105).

Heredity.—The action of this all-powerful factor in evolution is as constant in the underground world, and as difficult to comprehend in considering cave life, as that of the upper regions. It begins to act, of course, with the earliest generations, and continues to act with, so to speak, increasing force and precision as time goes on and the characteristics induced by a life in total darkness becomes more and more fixed.

It is evident that heredity has acted longest in those insects, such as the species of Anophthalmus and Adelops, whose larvæ are lacking in all traces of eyes and optic nerves and lobes. Heredity has here acted with unabated force throughout every stage of the metamorphosis; and, it will be a matter of great interest to ascertain whether any traces of the eyes may be met with in the embryo of these forms.

On the other hand, in those Arthropods in which the brain and optic nerves have persisted, with rudiments of the eyes (*e.g.*, Orconectes), where the eyes are larger in the young, it would seem as if heredity had been acting through a shorter period, and consequently, so to speak, with less momentum.

In the case of Machærites, in which the females only of certain species are said to be blind, while the males have well-developed eyes, we have an apparent exception to the continuous action of heredity; an exception paralleled, however, by animals living in the upper world, such as Termes, whose workers and soldiers are eyeless, though the males and females are eyed. They perhaps are twilight species rather than inhabitants of totally dark localities in caves, and those living in twilight may intercross with those

inhabiting the darker regions, and such a case as this, remarkable as it would appear, does not affect the general rule, that animals living in total darkness and never living in twilight, nor intercrossing with twilight forms, are eyeless, or at least blind.

Nor does the case of Hadenœcus, the cave cricket, with well-developed eyes and brains, affect the argument; for this is essentially a twilight form, though migrating to regions of total darkness and abounding there. The same may be said of the cave species of Ceuthophilus. A parallel case may be that of Chologaster as compared with Amblyopsis, the former living out of caves in ditches as well as in wells and caves.

Judging by the following statement, so eminent a naturalist as Professor Semper denies that heredity acts in the case of the mole. He says:

"This almost total blindness in the mole is the result solely of complete degeneration of the optic nerve, so that the images which are probably formed in the eye itself can never be transmitted to the animal's consciousness. Occasionally, however, the mole even can see a little, for it has been found that both optic nerves are not always degenerate in the same individual, so that one eye may remain in communication with the brain while the other has no connection with it. In the embryo of the mole, however, and without exception, both eyes are originally connected with the brain by well-developed optic nerves, and so theoretically efficient. This may indeed be regarded as a perfectly conclusive proof that the blind mole is descended from progenitors that could see; it would seem, too, to prove that the blindness of the fully grown animal is the result not of inheritance, but of the directly injurious effects of darkness on the optic nerve in each individual." [1]

It may be objected, however, that each mole certainly inherits a tendency to weakness and atrophy of the optic nerves, just as the children of consumptive or strumous parents inherit a tendency to those diseases, and that when the conditions are favorable the disease manifests itself. We know there have been many generations of blind or partially blind moles, and it would be strange if heredity did not at a certain age act in such a case, and would not for at least a few generations even if the moles were kept out of the dark-

[1] Animal Life, etc., pp. 79, 80.

ness. We have in the atrophy of the optic nerves of the mole a parallel case in the blind Myriapod *Pseudotremia cavernarum*, where the eyes survive but the optic nerve is wanting, as also in a less marked degree in some of the individuals of *Cæcidotœa stygia.*

The study of the conditions of existence in caves is of special value, because such conditions are so unusual and abnormal and the results upon certain organs so easily appreciated. It is by a study of life under unusual conditions that the attention is aroused and interest is excited, and after acquiring experience in dealing with the more palpable, because somewhat abnormal, circumstances under which organisms exist, we can then more easily observe the effects of changes of ordinary conditions upon the organism.

From a study of cave life, of organisms existing in saline and in heated waters, of plants and animals exposed to great cold in alpine or polar regions, of those living in hot, dry deserts, we can turn to an examination of the results of adaptation to a parasitic mode of life. The strange modifications of form, owing to disuse, in internal as well as external parasites of different orders and classes, the change of host necessitated, and the intensity of the struggle for existence in animals living under such exceptional conditions, embryology proving that they have arisen from animals of normal organization,—such studies as these are of fundamental importance in a discussion of the origin of species and higher categories. Moreover, the study of the results of the incoming and cessation of the Glacial epoch, the effects on life arising from the elevation and depression of the land, involving not only change of land surfaces, but a change of climate,—it is by a study of such marked changes as these in the conditions of life that we are prepared to examine the more subtle causes of variation throughout the organic world in general.

After the foregoing pages were written we read with much interest Mr. Herbert Spencer's recent essays entitled "The Factors of Organic Evolution."[1] While that author, it appears to us, lays too great stress on Dr. Erasmus Darwin's views, as compared with Lamarck's; the author of the Philosophie Zoologique having been a professional botanist and zoologist as well as a naturalist of the

[1] New York, 1887, reprinted from the Nineteenth Century for April and May, 1886.

first rank, it is noteworthy that he sees clearly that natural selection is not the sole factor in organic evolution, as will be seen by the general drift of his essays, by his quoting with approval Huxley's significant remark that "Science commits suicide when it adopts a creed," and by the following extracts from his own essays :—

"But now, recognizing in full this process brought into clear view by Mr. Darwin, and traced out by him with so much care and skill, can we conclude that, taken alone, it accounts for organic evolution? Has the natural selection of favorable variations been the sole factor? On critically examining the evidence we shall find reason to think that it by no means explains all that has to be explained" (p. 9).

During that earlier period, when he was discovering the multitudinous cases in which his own hypothesis afforded solutions, and simultaneously observing how utterly futile in these multitudinous cases was the hypothesis propounded by his grandfather and Lamarck, Mr. Darwin was, not unnaturally, almost betrayed into the belief that the one is all-sufficient and the other inoperative.[1] But in the mind of one usually so candid and ever open to more evidence there naturally came a reaction. The inheritance of functionally produced modifications, which, judging by the passage quoted above concerning the views of these earlier inquirers, would seem to have been at one time denied, but which, as we have seen, was always to some extent recognized, came to be recognized more and more, and deliberately included as a factor of importance.

In his references to the works and opinions of other naturalists Mr. Spencer confines himself almost exclusively to those of Mr. Darwin, who always opposed, and, it must be confessed, with less than his usual candor and fairness, the views of Lamarck as to the influence of a change in the environment upon organisms.[2]

It seems singular that Mr. Spencer should not be acquainted

[1] It is surprising to read in Darwin's Life, by his son, the expressions showing his lack of appreciation of Lamarck and his work; Darwin seems from the first to have been strongly prejudiced against Lamarck's views, and never to have done them justice.

[2] In the Origin of Species (p. xiv., note) Darwin writes, as quoted by Spencer: "It is curious how largely my grandfather, Dr. Erasmus Darwin, anticipated the views and erroneous grounds of opinion of Lamarck in his 'Zoonomia' (vol. i., pp. 500–510), published in 1794" (p. 29).

with the work of those who have brought together certain facts bearing on the physical factors of evolution.[1] The principal factors referred to by Mr. Spencer are use and disuse and the influence of light. In one place he does in concrete language sum up these agencies as follows :—

"The growth of a thing is effected by the joint operation of certain forces on certain materials; and when it dwindles there is either a lack of some materials or the forces co-operate in a way different from that which produces growth. . . . . That is to say, growth, variation, survival, death, if they are to be reduced to the forms in which physical science can recognize them, must be expressed as effects of agencies definitely conceived—mechanical forces—light, heat, chemical affinity, etc." (pp. 39, 40).

On page 70 Mr. Spencer remarks :—

"But nevertheless, as we here see, natural selection could operate only under subjection. It could do no more than take advantage of those structural changes which the medium and its contents initiated."

Again, on page 73, Spencer suggests that natural selection, in order to act, must have had a limited number of organisms upon which to operate.[2] As he remarks :—

"Though natural selection must have become increasingly active when once it had got a start, yet the differentiating action of the medium never ceased to be a co-operator in the development of these first animals and plants."

[1] In the writer's Introduction to the Standard Natural History, 1885, under the head of Evolution (pp. 1 and lxii.), he has endeavored to bring together references to the different authors who have insisted on views which are in the line of those first suggested by Lamarck, a phase of evolution which we have called Neolamarckianism. The authors to whom Mr. Spencer might have with good reason referred are, in Europe, Semper, Kölliker, Wagner, Martins, Plateau, Weismann, and Dohrn, and in this country Haldeman, Leidy, Wyman, Clark, Cope, Hyatt, Walsh, Allen, W. H. Edwards, Dall, and the writer.

[2] This point is one which the writer has also made and published over twelve years ago in a communication to the Nation, holding that it is an important objection to the theory of natural selection, the very nature of which involves the existence of a world already stocked with life forms. What the theory of evolution should explain is the origin of these first ordinal and class forms. Given even a scanty fauna, isolated members of different orders and classes, and it is comparatively easy to account for the origin of the later more numerous descendants.

Finally, Mr. Spencer makes the following important admission:—

"This general conclusion brings with it the thought that the phrases employed in discussing organic evolution, though convenient and indeed needful, are liable to mislead us by veiling the actual agencies. That which really goes on in every organism is the working together of component parts in ways conducing to the continuance of their combined actions in presence of things and actions outside, some of which tend to subserve and others to destroy the combination. The matters and forces in these two groups are the sole causes properly so called. The words 'natural selection' do not express a cause in the physical sense. They express a mode of co-operation among causes, or rather, to speak strictly, they express an effect of this mode of co-operation" (p. 40).

Here we have frankly intimated what the Neolamarckian has for years insisted on, that the phrase "natural selection" is not a *vera causa*, but rather expresses the results or effects of the co-operation of a number of factors in organic evolution. In the case of too many naturalists the dogma or creed of natural selection has, it seems to us, tied their hands, obscured their vision, and prevented their seeking by observation and experiment to discover, so far as human intelligence can do so, the tangible, genuine, efficient factors of organic evolution.

EDITORS' TABLE.

EDITORS: E. D. COPE AND J. S. KINGSLEY.

The bringing into cultivation of the arid regions of the United States would increase the agricultural resources of the nation by one-third. The man who should devise a successful method of doing this would be one of the benefactors of his kind and country. The region to be thus reclaimed includes a wide strip extending north and south, east of the Rocky Mountains; a large part of the drainage basin of the Rio Grande; the hydrographic basin of the Great Colorado, and the Great Basin of Utah and Nevada. Small portions of all these regions are at present

rendered productive by irrigation, and give an earnest of the great possibilities which await the entire region. The productiveness of the Great Basin of Utah and Nevada would be equal to that of the most favored of temperate regions of the earth were water only accessible, as the results of irrigation by the Mormons and others have demonstrated.

The attempt to supply the lack of water by artesian wells has proven successful only in limited localities, and it has been long evident that some other source of supply must be looked for. Major J. W. Powell having given the subject his attention for many years, has at leached a solution as nearly adequate as the circumstances permit. He has proposed to Congress that the U. S. Government dam up the waters of the streams and rivers which issue from the various Rocky Mountain ranges, and thus accumulate their waters for a wholesale system of irrigation.

There appears to be nothing impracticable about this proposition. The manner in which the rivers issue from the Rocky Mountains in narrow canyons seems to be well adapted for the execution of such an enterprise. The artificial closing of the canyons of the Platte and Arkansas on the east, of the Rio Grande on the south, and of the Green and Gunnison on the west, would seem to present no great engineering difficulties, and immense bodies of water would be thus secured for purposes of irrigation. The benefits to agriculture resulting would be immense, and regions now almost useless to mankind, would become well populated. Some large regions would, however, not be reached by this system, especially a great part of the Great Basin.

Congress has appropriated $100,000 towards this important project, to be expended under the direction of Major Powell. We observe with pleasure that Major Powell regards this enterprise as entirely distinct from the U. S. Geological Survey. We hope he will continue to resist the attempt of some members of the lower House to saddle the expense of this undertaking on the Geological Survey; otherwise we will have another and gigantic illustration of a purely scientific enterprise swamped by the utilitarianism which is so rampant and all-absorbing in this country.

GENERAL NOTES.

GEOGRAPHY AND TRAVEL.[1]

ASIA.—Lieut. Younghusband's journey through Central Asia and over the Mustagh Pass.—Subsequent to his sojourn in Manchuria, in company with Messrs. Fulford and James, Lieut. Younghusband undertook, and successfully accomplished, an adventurous journey across Central Asia and thence into Hindostan by way of the Mustagh Pass, which had not previously been crossed by any European. His route from Pekin to Chinese Turkistan was the most direct and least frequented one, leading across the Gobi desert in a line lying between that traversed by Mr. Ney Elias, in 1872, and that followed by Marco Polo six centuries ago. As there is no silver coinage in China, the traveler set forth with some 60 lbs. of solid silver. The first place of importance reached was Kalgan, whence the caravans start for Kiakhta on the Russian frontier. Thence the valley of the Hoangho was ascended through a desolate loess country, where the villages were half in ruins, the roads were sunk thirty to forty feet below the surface of the soil, and horrible sandstorms were of almost daily occurrence in the spring. A hilly country, actually in Mongolia, but inhabited by Chinese, was then traversed for two days, when the traveler emerged upon the real steppes. The Great Wall, which is a magnificent affair near Pekin, has on the Mongolian frontier dwindled to a miserable mud wall not twenty feet high, with gaps in it often from a quarter to half a mile in width.

The Mongols, though a strong and hearty people, are said to have entirely lost their old warlike spirit, largely in consequence of the policy of the Chinese Government, which encourages the males to become Lamas. Sixty per cent. of the men are said to be now enrolled among these non-fighting celibates. Chinese immigrants are invading Mongolia as they have done Manchuria, and are taking to Mongolian habits sufficiently to, in some cases, fatten sheep for the Pekin market. At Kuei-hua-cheng, an important place of trade with Mongolia, camels were hired for the transit of the desert to Hami. After crossing the Galpin Gobi, Mr. Younghusband passed along the southern part of the Hurku Hills, crossing Prejevalsky's route at the Bortson well. For 190 miles the way lay over a plain lying between the Hurku range and a similar but rather lower range to the south of it. Near the end of the Hurku range, which here attains a height of about 8,000 feet, there is a

[1] **Edited by W. N. Lockington, Philadelphia, Pa.**

curious line of sand-hills attaining a height of 900 feet, and some forty miles in length, evidently formed by the wind driving the desert sand up into the hollow between the two rocky ranges. A depression of about eighty miles separates the Hurku range from the out-lying spurs of the Altai. The Altai range is here perfectly barren, the upper part formed of bare rock, while the lower is a continuous slope of débris. The cold winds of winter and the fierce sun of summer crumble the rocks, but the lack of rainfall causes the fragments to lie where they fall. After crossing the desert of Dzungaria, the Tian-Shan range was traversed at a height of 8,000 feet above the sea. The 1,255 miles between Kuei-hua-cheng and Hami were accomplished in seventy days. From Hami the party passed through Pichan, Turfan, Karashar, Kuchar, Aksu, and Ush Turfan, along the valley of the Aksu river, across the Belowti Pass (11,000 feet) and over the plain called the Syrt, to Kashgar, and thence to Yarkand. Here Lieut. Younghusband determined to attempt the Mustagh Pass, which is the shortest way into Kashmir, but has latterly fallen into disuse because of the raids of the Kanjut robbers. The Tupa Dawan Pass, a very easy one, 10,400 feet high, was crossed, and the valley of the Tisnaf, a tributary of the Yarkand, ascended. The next pass was that of Chiragh Saldi, after which the valley of the Yarkand was reached. This river here flows due west, but afterwards turns north to Yarkand.

On leaving Yarkand the party ascended the Surukwat stream to the Aghil Dawan range, which, after passing two more gorges, rose like a wall in front of them. Fortunately they struck the right path, and after some winding among the spurs, crossed the range through a great gap, over a long gravel slope. From a hill beyond the summit of this pass, standing at a height several hundred feet above the top of Mont Blanc, the great Karakoram or Mustagh range, forming the water-shed between the rivers that flow into the Indian Ocean and those of Central Asia, was visible as a succession of needle peaks like hundreds of Matterhorns, rising several thousands of feet higher still. Mr. Younghusband estimates the Aghil Dawan range at some sixteen to seventeen thousand feet. From it he descended to the Shaksgam river, hitherto unknown to geographers, though nearly equal in volume to the Yarkand, of which it is a tributary. Leaving this river, the Sarpo Laggo, a stream flowing from the glaciers of the Mustagh Pass, was ascended, and soon a full view was obtained of the second highest mountain in the world, then known only by the surveyors' designation of K2, but since named by Gen. J. T. Walker, Peak Godwen-Austen. At this point serious difficulties commenced. There are two Mustagh Passes. The new one, which had been found after the abandonment of the old pass on account of the accumulation of ice, was found to be impassible for the same reason, so an attempt was made

to cross by the old pass, leaving the ponies behind. Through deep soft snow, at a level of 19,000 feet, the travelers labored on till they reached the summit, whence no way of descent appeared save by crossing an icy slope to a cliff too precipitous for ice or snow to lodge upon it, and by descending this cliff to more icy slopes below it. By making a rope out of every available material, and by hewing steps, the descent was at last accomplished without serious accident, only to find themselves on an extensive glacier full of crevasses. At night they emerged upon a dry spot, but on the next day they crossed the great Baltoro Glacier, and it took two days more before they reached the village of Askoli. Supplies were sent back to the coolies with the ponies, and seven weeks later this part of the caravan reached Skardo by the Karakoram Pass route.

Africa.—British Basuto Land.—The August issue of the *Proceedings of the Royal Geographical Society* contains a map and an account of that part of Basuto Land that was saved to the Basuto in 1868. It is bounded by the Orange Free State, Natal, and Cape Colony. From the first of these it is divided for 130 miles by the Caledon river, and the country between this stream and the Drakensberg has been known to Europeans for some fifty years, while the larger section of the district, comprising the basin of the head-waters of the Orange river, has been little explored. The Drakensberg, which continues northward from Basuto Land into the Transvaal, appears to have originally been a sandstone plateau eight to ten thousand feet in height, the upper stratum of coarse friable rock sloping to the south and west, but falling away in perpendicular cliffs to the eastward. The range is now everywhere intersected by streams which have cut courses for themselves two to three thousand feet below the normal level of the mountains. A swamp about a mile across, at an elevation of 9,560 feet, gives rise to the Sengu, or principal source of the Orange River.

The last remnant of the Bushmen of this region were, in retaliation for repeated cattle thefts, destroyed by the grandsons of Moshesh, the consolidator of the Basuto tribe. Sir M. Clarke thus describes the cave Sehonghong, the home of the last Bushman chief, Soai: "It is a simple overhanging rock, the wall in the rear being covered with pictures of hunting scenes, war dances, predatory expeditions and various wild animals. Eland, hippopotamus, and the smaller buck are recognizable, while occasionally is depicted the uncouth form of the rain-god. In all the fighting pictures the Bushman is shown victorious. He is drawing the bow with tiny hands, or balancing himself on shapely feet, throwing the assagai. His foes, on the other hand, are exhibited with disproportionately big hands, fleeing on calfless legs stuck like broom-handles into the middle of their feet, and in the rear appear Bushwomen and boys driving herds of horses and cattle, the spoils of victory."

Mr. J. Thomson's Travels in Morocco.—Mr. Joseph Thomson is now traveling in Morocco, where by cleverly-planned excursions he has entered the mountain fastnesses and done more than any previous traveler. From Demnat he made two interesting trips into the lower ranges, and visited some remarkable caves and ruins, as well as one of the most wonderful natural bridge-aqueducts in the world. He then made a dart across the main axis of the Atlas to the district of Tiluit in the basin of the Draa. As the tribes further west were in revolt, he was compelled to return to the northern plains. He then crossed the mountains by a pass a little south of Jebel Tizah, and reached the Gindafy safely. After a trip up a wonderful cañon, and the ascent of a mountain, whence the party were compelled to return, though by a new route, to their starting point. Mr. Thomson again crossed the mountains, and with no small difficulty and danger ascended the highest peak of the Atlas range north of Amsiviz, to a height of 12,500 feet. He then returned to Morocco, whence he wrote to the London *Times* on July 22. He proposes to make his way up the Urika river, and to work round to Mogador.

The German East African Possessions.—The *Mittheilungen* of the Vienna Geographical Society for June has an article by Dr. Hans Meyer on the German East African Protectorate, which is said to comprise the East African coastlands, terraces, and plateaus for a distance north and south of 550 miles, and east and west of 150 miles. The southern boundary is the Rovuma river, and a conventional line run from thence to Lake Nyassa, while to the north it is conterminous with the British Protectorate, from which it is separated by a line passing from Lake Victoria Nyanza in an oblique direction along the north foot of Kilima-njaro to the coast at about 5 S. Lat., below Mombasa. It thus includes the head-waters of streams flowing to the Nile, Congo, and Zambesi.

America.—Schöner's Globe of 1523.—Messrs. Stevens and Sons, Great Russell street, London, have recently published a work which has considerable interest to all who study early American geography. Johann Schöner, Professor of Mathematics at Nuremberg in the early part of the sixteenth century, not only made a series of terrestrial globes, but left also a small pamphlet of four pages dated 1523, and thus later than the two first of his globes, which were dated 1515 and 1520. This pamphlet contains references to a globe on which were marked the discoveries of Magellan —discoveries that are not shown on Schöner's earlier globes. In 1885 Mr. Stevens found a fac-simile of this very globe in the catalogue of a Munich bookseller. The reproduction of Schöner's pamphlet and globe in fac-simile, with a translation and an intro-

ductory sketch of the early historical geography of America, together with a life of Schöner, and fac-similes of his earlier globes, constitute the present volume. In Schöner's globe of 1523 America is for the first time shown as a continent, instead of being broken up into many islands, as is the case in all earlier globes. Florida is for the first time named in print, the Moluccas have found their real place, as have many of the real isles of the sea, while all the monsters and bogus elements of American geography have disappeared.

French Guiana.—M. Coudreau, who has recently returned to Cayenne, after a sojourn of eleven months in the western Tumac-Humac range, between the sources of the Itany and the Camopy, states that the country is a magnificent one, and the climate not bad. The party, having exhausted their provisions, lived out in the open air with the Indians, and led the same life with them. M. Coudreau became so popular with the Rucuyennes that he induced the *pamenchi* of the tribe and four of his men to accompany him to Cayenne, where their arrival caused a sensation, and where the Governor made them very welcome.

M. Coudreau has discovered the existence in undoubted French territory of sixteen new tribes of Indians, forming a group of 20,000 persons. These Indians are sedentary, and have attained a certain degree of civilization.

Geographical News.—The *Bolletino* of the Italian Geographical Society contains an account of the travels of Leonardo Fea in Tenasserim. The explorer ascended Mt. Mulai, the culminating point of the district (6,300 feet), after having followed the courses of the Jeeayngmyit and its great southern tributary, the Unduro. From Meetan the northward route to Tagata and Mulai passed through the little-known hilly country of the Ayaeen Karens.

M. Pavie, French Vice-Consul at Luang-Prabang, has succeeded in reaching Tonquin from that place by two routes, the more practicable of which seems to be that which passes to the northeast along the valley of the Namseng, a tributary of the Mekong, and then crosses the mountains forming the water-shed between the Mekong and Red River basins.

Baron H. von Schwerin recently gave an account to the Swedish Geographical Society of his expedition to the Congo region, where he explored the basin of the Inkissi, one of the tributaries of the Congo, and made from Banabna an excursion southward into the country of the Mushirongi, never before visited by a European. He also made a trip into the lands of Kakondo and Kabinda, north of the Congo mouth.

The population of the Caucasus, which in 1858 was only 4,526,000, had in 1880 risen to 5,870,000, the immigration of Cossacks and Russian peasants more than counterbalancing the emigration, while all districts have a regular excess of births over deaths. The Russian element is now in excess of any other, consisting of 1,410,000, while the Georgians are but 1,150,000 in number, and the Lesghiens and mountaineers have diminished since 1858 from 1,400,000 to 1,050,000.

Lukoma, the principal island in Lake Nyassa, though only four and a half miles long and two and a half wide, contains 2,500 inhabitants. Ula, or witchcraft, of the kind described with much graphic force by Mr. Rider Haggard in one of his earlier works, prevails and is a great curse in the island.

Herr Aug. Fitzau (*Deutsche Geographische Blatter*) gives an account of the West African seaboard between Morocco and the Senegal. Though Arabic is the prevalent language, he believes that the old Hamitic or Berber is still the chief ethnic element. The writer describes in detail the coast between Agadir and St. Louis.

Count Teleki has ascended Mt. Kenia to a height of 15,000 feet, and believes its elevation to be greater than that of Kilima-njaro. Corrections made by Dr. H. Heyer himself in the barometrical observations taken during his ascent of Kilima-njaro prove that he did not reach within 820 feet of the summit of the mountain.

Petermann's *Mitteilungen* (Part 5) gives an account of a partial exploration of the small and little-known group of the Nanusa Islands, seven in number, and situated in 4.35 N. Lat., and 127.5 E. Long. Only three of the islets—Karaton, Mengampit, and Onrata—are inhabited, and the total population is about 1,000. All the islands are girt by reefs, and the only good anchorage is on the east side of Karaton. Mengampit has a hill, 800 feet high, in its centre, and is well wooded, but Karaton is flat.

GEOLOGY AND PALÆONTOLOGY.

THE EXTINCT SCLERODERMS.—By reason of the deviation from copy of the note on "Some Extinct Sclerodermes" in the AMERICAN NATURALIST for May, 1888, p. 448, it might be inferred that there were more extinct genera of Balistids than are really known. The genera are (1) *Balistomorphus* Gill (=*Acanthoderma* Ag. 1843, not Cantraine 1835) and (2) *Bucklandium* Koenig (=*Glyptocephalus* Ag. 1843, *fide* Pictet, not Gottsche 1835).

The part of Professor Zittel's valuable "Handbuch der Palæontologie" (III. Band, 2. Lief.) describing the Teleost fishes, has recently appeared. The correlation between the morphology and systematic relations of existing and extinct fishes has been obscured and sometimes contradicted by the adoption of the very misleading and unscientific classification of Günther. The anachronistic idea that there is near relationship between Plectognath and Ganoid, fishes is consequently likewise still adhered to.[1] This idea has been so thoroughly exploded by several writers and its fundamental error is so obvious to any one who considers the evidence and compares the structural characteristics of the various types, that surprise must be felt that so intelligent a palæontologist as Professor Zittel clings to it. There can be little, if any, doubt to any competent observer who compares the skeletons and other parts of Scleroderm fishes with the Teuthidids and Siganids that the views of Dareste, Cope and others are correct, that the Scleroderms have originated from the same stock as the Teuthidids, and that consequently they are removed further than most fishes, and further even than the related Teuthidoidea, from the Ganoids. The genus *Protobalistum* is adopted by Professor Zittel with the expanded limits recently assigned to it by Baron de Zigno. To those who adopt Dr. Günther's views of the classificatory value of characters, the demonstration of the erroneous association of the forms embraced under the genus is easy. The relative size of the spinous and soft portions of the dorsal furniture are regarded by Dr. Günther as of *more than family* value, as in the case of his *Acanthopterygii perciformes, A. cotto-scombriformes, and A. blenniiformes.* Now, just such differences as have been used to separate those groups are found between the two fishes referred to the genus *Protobalistum* by Baron de Zigno and Professor Zittel. The *P. imperiale* has the spinous dorsal *much longer* than the soft, while the *P. Omboni* has the spinous dorsal *much shorter* than the soft. Therefore the differentiation of the two species not only generically but as family types follows. It is not even certain that the typical *Protobalistum* is a true Scleroderm.

The diagnostic characters of the several families of Scleroderms are as follows :—

PROTOBALISTIDÆ.—Scleroderms[2] with the spinous dorsal very elongated and composed mostly of long spines separated by consid-

[1] "Diese......Fische zeichnen sich besonders durch ihre eigenthümliche, bald aus harten rhomboidischen Schuppen, bald aus knöchernen Schildern, Stacheln oder Platten bestehende Hautbedeckung, sowie durch die innige Verwachsung der meisten Kopfknochen aus. Agassiz rechnete sie noch zu den Ganoiden, mit denen sie in der That mancherlei Uebereinstimmung aufweisen." Zittel, op. cit., p. 257.

[2] It is possible that the Protobalistids may prove to be not Scleroderms but Acanthopterygians.

erable intervals, the soft dorsal short, and with ventrals atrophied or represented by weak spines.[1]

TRIACANTHIDÆ.—Sclerodermes with the spinous dorsal very short and composed of a stout anterior spine and several approximated weak ones behind it, the soft dorsal oblong, and with ventrals represented by stout spines, and with or without weak axillar rays.

BALISTIDÆ.—Sclerodermes with the spinous dorsal very short, being represented (1) by a stout spine with which a weaker posterior spine interlocks in erection (and often a third spine exists), or (2) by only a single slender spine; the soft dorsal long or oblong, and the ventrals wanting.

These characters are supplemented by important osteological ones for the last two at least.

The family Triacanthidæ was represented in the eocene seas of Europe by the genera *Acanthopleurus* (Ag.) and *Protacanthodes* (Gill). The affinity of the former to *Triacanthus* was remarked as long ago as 1859 by von Rath (*Zeitschr. deutsch. Geol. Ges.*, V. ii., pp. 130–132).

Other genera referred to the sub-order of Sclerodermes (*e.g.*, *Blochius*, *Dercetis*, *Styracodus*, *Chilodus*, *Cœlorhynchus*, *Ancistrodon*) are quite remote from it.—*Theo. Gill.*

SECOND NOTE UPON ROMANOVSKY'S MATERIALEN ZUR GEOLOGIE VON TURKESTAN.—In the Tertiary, as in the Cretaceous, the absence of fossils renders it almost impossible to mark off stages, and even precludes the exact determination of the base of the group. It would appear that the continuity is complete, and that Eocene, Oligocene, Miocene, and Pliocene are all represented. The Nummilitic has been met with only upon the borders of the Aral Sea, where it is overlaid by the sandstones, clays, and limestones belonging to the Oligocene, which are surmounted by the Miocene limestones, and by the argillaceous beds of the Sarmatic stage; these last form the upper layer of the plateau of Ust-Urt. Conglomerates, which form heavy beds in the mountains, are gradually replaced by rocks of finer grain as the distance from their feet increases. The Cretaceous strata of Turkestan contain important beds of phosphorite (mouth of the Syr-Daria), of gypsum (Tian-shan, Pamir), petroleum (Fergana), and sulphur (basin of the Amou-Daria); and the Tertiary has intercalations of salt and gypsum (Sangar, Samarcand), the thickness of which diminishes gradually towards the west.

The history of Turan during the recent geological periods has many features in common with that of the rest of Central Asia, and especially with that of Afghanistan. After the continental

[1] See de Zigno, p. 4; Am. Nat., 1888, p. 447, note.

phase of the Jurassic, came the marine invasion corresponding to the deposition of the Cretaceous beds; sedimentation then continued quietly and tranquilly during the Tertiary period, at the bottom of a sea at first open to a large extent and communicating freely with the ocean, but the area of which was always diminishing, until in the Sarmatian epoch this Mediterranean became closed, and was gradually converted by evaporation into distinct sheets of water, the remnants of which still remain and diminish under our own observation. During these ages the great mountain border of the East gained in height and in development. The Pliocene is at its summit intimately connected with the Aralo-Caspian deposits, which are chiefly composed of the debris of the Cretaceous and Tertiary strata, the slight cohesion of the older deposits facilitating greatly the disintegration effected by atmospheric agencies. The Aralo-Caspian fossils belong to species that now inhabit the Caspian and Aral Seas, and their nature and mode of distribution is such that, taken in conjunction with what is known of the existing Caspian fauna, it is possible to ascertain the exact circumstances in which the sediments were laid down; since all the species except *Cardium edule* and *Lithoglyphus caspius* live near the coast, at depths never exceeding fifteen metres. The Aralo-Caspian Sea consisted of two immense basins, the western corresponding to the Caspian, though immensely more extensive than its existing shrunken remainder; while the eastern comprised the Aral, but extended far beyond it (according to Ssevertsoff it reached Lake Balkash). The western sea was much the larger and more profound, and the eastern was strewn with scattered islands. Between these basins the plateau of Ust-Urt formed a long peninsula, and the basins communicated by a sinuous strait passing through Lake Sarykamish. The part of this strait leading from the Caspian to Sarykamish is the present Usboi, and, though considered by Grimm as an ancient bed of the Oxus or Amou-Daria, can never have been such, as its bed contains no traces of alluvium, but consists of Aralo-Caspian deposits. The facts indicate that in the Aralo-Caspian epoch the Oxus, taking in the Khiva region the course of the present Urun-Daria, fed Lake Sarykamish, which rapidly dried up when the river turned aside to the benefit of the Aral. The winds from the north and northeast have transformed into deserts the dry beds of the ancient lakes, and have formed those long ranges of dunes called *Barkhans* that cover such vast spaces throughout Turkestan.

Rütimeyer on the Classification of Mammalia, and on American Types recently found in Switzerland.[1]—

[1] Ueber einige Beziehungen zwischen den Saügethierstämmen alter u. neuer Welt. Erster Nachtrag zu der Eocenen Fauna der Egerkingen; von L. Rütimeyer; Zurich, 1888. Abhandl d. Schwiez. Palæontol. Gesselsch. Bd. XV.

This important memoir is divided into two portions as indicated in the above title. I refer to the second part first in order, by recording the discoveries it announces. Prof. Rütimeyer has made the highly interesting discovery of a species of Phenacodus at Egerkingen, which he names *P. europœus*. He also refers species from the same locality to the genera Protogonia, (?) Mioclænus, and (?) Pelycodus, and to the new genus Meniscodon. Unfortunately all of these species are known from the teeth only, so that the references are not yet final. He also gives descriptions of new specimens of *Cœnopithecus lemuroides* Rütim. and *Proviverra typica* Rütim.

In the first part of the memoir, Prof. Rütimeyer discusses the relations of the various members of the Ungulata, with reference to their classification. This consists chiefly of a criticism of the system proposed by Cope, and the results he reaches are expressed as follows: (p. 62).

First.—That the categories of Ungulata, based by Cope on the nature of the mutual carpal and tarsal articulations, do not furnish exact definitions for systematic use. Although they furnish instructive series of modifications of the mechanism of motion, they do not offer sharp lines of distinction. Especially can the so-called condylarthrie have a very relative value, and between it and the diplarthrie is there no sharp line.

Second.—The plan of structure which characterizes the superior molars of the Condylarthra consists in a disposition of the tubercles, to which he applies the name trigonodontie, since there are three principal tubercles arranged *en triangle,* two external and one internal, so that the cross-valley of the crown is closed within. It is this type of dentition which is common among lemurs and Insectivora, and which prevails among Carnivora. It is thus probable that trigonodontie is to be regarded as an earlier and more primitive form of molar than those of the zygodont (quadritubercular) type. The selenodont type appears to have arisen from trigonodont ancestors.

Third.—The trigonodont structure of superior molars as is present in the Condylarthra is by no means confined to American Ungulata, but is found in Europe even to generic details; so that it is probable that the foot-structure of the Condylarthra will be also found in Europe.

Fourth.—It is therefore not necessary to look to America alone for the first known ancestors of the horse.

Fifth.—Except the Dinocerata, which, like the Toxodontia, has a limited range in America, the types of Mammalia have developed in such complete parallelism that we are compelled to look to a common and extensive geographical source for them.

Sixth.—Among the false-lemurs, the Cænopithecus of Egerkingen

appears to be as nearly allied to the North American Mesodonta as to the European Adapis.

I propose to offer some observations on these propositions, especially to the first and second. The third, and those following, relating as they do to the important discoveries of Prof. Rütimeyer at Egerkingen, constitute valuable additions to the sciences of palæontology and mammalian phylogeny.

The first proposition, that the characters of the carpus and tarsus on which I have relied for discrimination of the orders of Ungulata are insufficient for that purpose, is probably so far true, as a similar assertion made with regard to all structural characters whatever would be. With the discovery of new forms, and the completion of phylogenetic lines, the sharp demarcations we now employ as definitions will vanish. But I claim with regard to the case of the Condylarthra, *that such discoveries have not been yet made*, and that Prof. Rütimeyer's views on this point have been reached by reason of several misconceptions on his part. The supposition that the tarsus of Phenacodus (p. 14) resembles in any degree that of the rhinoceros and tapir, is an unaccountable error. Also (l. c.) the supposition that the carpus of those animals does not represent the diplarthrous type is an equally extraordinary misconception. So is (p. 15) the opinion that such small contact of the astragalus with the cuboid bone as exists in Phenacodus and Hyrax is diplarthrism comparable to that of *Hyracotherium venticolum.*

But supposing Prof. Rütimeyer's view that the carpus of Phenacodus is proboscidian, and the tarsus rhinocerotic, to be correct, an order distinct from Proboscidia and Perissodactyla would be indicated.

The fact is that Prof. Rütimeyer, probably from want of specimens of Condylarthra, has not fully grasped the meaning of the taxeopod, and especially the Condylarthrous type of carpus and tarsus. That type is the unguiculate and carnivorous, accompanying hoof-shaped ungues, and as yet *no transitions* to the usual ungulate type have been found *within the Ungulata*, except in the carpus of the Anthropomorpha (and the result is not typically ungulate). The Condylarthrous carpus and tarsus are also *lemurine*, and are well distinguished from other ungulate types. The structure of the astragalus of Dissacus among the Unguiculates shows us what the transition will be like when it is found.[1]

The second proposition ascribes what Prof. Rütimeyer calls trigonodontie as a definitive and general character of the Condylarthra. I must here record an objection to the introduction of the word trigonodont. It is proposed to replace the term tritubercular among the Ungulata, so that the latter phrase shall apply only to the Unguiculata. But there is absolutely no difference between

[1] Transactions Amer. Philosophical Society, 1888, pp. 343–4.

this type of tooth in the two divisions of Mammalia, and by introducing a new word we obscure this important identity, as well as encumber our memory and literature. The introduction of unnecessary terms has been long a vice in science, but it is now reaching such proportions that specialists must agree to protest against it. Tritubercular and trituberculy or trituberculie are certainly sufficient for all practical purposes.

As regards the use of this character as definitive of the Condylarthra, there is no doubt of its prevalence, and that traces of it can be found in the quadritubercular molars of many Phenacodontidæ. It is hard, however, to see it in *Protogonia puercensis*,[3] and is so little pronounced in various species as to make it, like many other characters that are important when fully developed of little more than individual value. As regards the phylogenetic significance of the tritubercular molar, I of course agree with Dr. Rütimeyer's indication, having already expressed the same in various publications, but first in 1884.[1] Of this priority, Dr. Rütimeyer is probably not aware.

I must here correct two misquotations of my writings which have slipped into Dr. Rütimeyer's text, both on p. 12. First, that I have regarded diplarthrism of the astragalus as a primitive character. I have, on the contrary, always regarded it as a high specialization, and have so stated many times in print, and never otherwise. Second, that having placed Hyrax in the Taxeopoda on one page, changed my view on a subsequent page. (Tert. Vert. III, p. 382). This is also a misconception; reference to the page cited shows no such change, nor has any such change of opinion ever been made by me.

Dr. Rütimeyer refers to his early paper on the Odontographie der Hufthiere, published in Basel in 1863.[3] I must now confess my own shortcoming in not having long ago studied this important memoir. In this study of the structure of the molar teeth of the Ungulata Prof. Rütimeyer *anticipates by ten years the same results reached by Kowelevsky and myself in 1873.* For the first determination of these homologies *exclusive credit is due to Prof. Rütimeyer.* He divides the molar teeth of Mammalia into three categories, the simply conic "Homœodont;" the vertically plicate, "Elasmodont;" and the cross-crested by junction of four tubercles, the "Zygodont." To the homœodont I subsequently gave the name hoplodont, which name must be suppressed. So also with my term ptychodont, which must give way to the prior elasmodont. As to zygodont, I prefer to recognize two types of molar crown in this series instead

[1] Transac. Amer. Philos. Society, p. 352, fig. 12.
[2] American Naturalist, 1883 (April), p. 407, and Proceedings American Philosophical Society, 1873-4, p. 324.
[3] Verhandl S. Naturforsch. Gesselsch Basel II, 1863, p. 558.

of but one, viz.: a simply quadritubercular, and a specialization of it where the tubercles are connected together by crests. For the former I used Kowelevsky's term bunodont, and to the second I gave the name lophodont. I find the zygodont idea too comprehensive, and also too restricted as applying only to cross-crests, while longitudinal crests (as in Rhinoceros) are embraced in my idea and corresponding term of lophodont.

Prof. Rütimeyer also ascertained that the remaining internal cusp of the tritubercular superior molar is the anterior internal.

It is difficult to ascertain from Prof. Rütimeyer's memoir to what extent he translated his homological determinations into phylogenetic equivalents. His language allows us to suppose for instance that in Ungulata, bunodont molars are derivatives from lophodont types, and simple premolars from the complex; but it is not certain that he wishes us to regard him as holding such an opinion. The histories of the tritubercular and tuberculosectorial and triconodont molars and the resulting phylogenetic deductions, are not embraced in this memoir.—*E. D. Cope.*

Geological News.—General.—Two recent works of M. A. Daubree, the one upon subterranean waters in the present epoch, and their composition from the point of view of the part they play in the earth's crust; the other upon the *rôle* of subterraneous waters in ancient epochs, are worthy of attention from all who are interested in rock-formation. A lengthy review of both will be found in the *Neues Jahrbuch für Mineralogie, Geologie, und Palæontologie*, II, Band, Zweites Heft., 1888.

Petermann's *Geographische Mitteilungen*, XXXIII., 1887, contains a geological map of Africa upon a small scale, accompanying an article by Dr. Gûrich. The sketch is colored to show six formations, but a large portion of the continent is, as might be supposed, left uncolored. The crystalline rocks, including the Silurian clays, predominate on the southeastern, southwestern, Red Sea, and Guinea coast districts; the Palæozoic, which as colored includes the Dyas in the Atlas Mountains, but excludes that formation elsewhere, is prominent only in patches of the Sahara, and in South Africa; the Karroo-formation, which in the south includes Dyas and Trias, covers all South Africa save the portions occupied by the crystalline and palæozoic rocks, and reappears in large patches on the eastern and western coasts, as well as in the Niger region; the Cretaceous is most conspicuous in the north, where it occupies the greater part of the Barbary States west of Barca; and the Tertiary strata cover the entire lower Nile valley, and stretch along the Mediterranean west to the Gulf of Sydra. From the head of the eocene to Khartum cretaceous rocks are shown bordering the Nile. The principal mass of the younger

eruptive rocks is in Abyssinia, where they are of early tertiary date.

The author gives the following summary. The African continent falls into three distinct geological regions: (1) The Atlas, which comprises a tolerably complete series of formations, that collectively have undergone similar disturbances to those that have taken place in the Alps; geologically, this region belongs to Europe. (2) The Desert region is distinguished by the horizontality of the Palæozoic strata and by great gaps below the chalk; the latter formations show a development corresponding to that of Syria and Arabia. (3) The South African region, which consists of a boss of crystalline mountains of enormous extent, covered with innumerable layers of horizontal sandstone, the age of which lies between that of the Carboniferous and that of the Jura. Analogous conditions occur in India. The marginal zone of later formations is also characteristic.

I. C. Russell contributes to the August issue of the *Geological Magazine* a summary of what is known of the geological history of the Jordan-Arabah depression, which offers so many points of resemblance to the Great Basin of North America that he ventures some suggestions and hypotheses.

Devonian.—Numerous crinoids collected in the Lower Devonian strata of Bundenbach and Gemunden are described by Dr. O. Follman in the *Verh. d. nat. Jahrg.*, xxxiv. 5 Folge, IV. Bd., pp. 113–138. Seven new species are described and figured.

Cretaceous.—Nœtling distinguishes three groups of strata in the cretaceous of Syria and Palestine. The uppermost contains Gryphæas and Cephalopoda, but is without Nerinea and Rudista. The upper part consists of chalk with flints, the lower of bituminous shales and lime, and the group corresponds to the Senonian. The middle group corresponds to the upper Turonian, and contains numerous Rudista, Cephalopoda, and Nerinea, but no Trigonias or Cythereas; it consists of dazzling white thick limestones with alternating beds of gray clays, but contains no flints. The lowest group has many Trigonias, Cythereas, and Nerineas, but few Cephalopoda and Rudista; it consists of sandstones, clays, and arenaceous limestones, and is identified with the lower Turonian. The Syrian cretaceous is distinguished from that of Europe by the absence of Belemnites and Inocerami. The Trigonia sandstone of the lowest group has a European character, while the Senonian resembles that of Africa.

Cænozoic.—According to M. Gaudry, the following are the heights of the largest fossil mammals that have yet been discovered:

(1) The *Dinotherium giganteum* from the upper miocene of Attica, the tibia of which, brought from Pikermi by M. Gaudry, measures 0.94m. in length, representing a height of 4.43m. at the shoulders, and 4.96m. at the top of the head. (2) The *Elephas antiquus*, found in the quaternary near Paris, height at the withers 3.95, and to the summit of the head 4.42m. (3) The *Elephas meridionalis* from the pliocene of Durfort, which is the largest entire mammalian skeleton (fossil) yet known, and is now at the Palæontological Museum in the Jardin des Plantes; its height at the shoulders is 3.77m., and it measures 4.42m. to the top of the head. (4) The *Mastodon americanus* from the quaternary of the United States measures 3.55m. to the top of the head. (5) The *Elephas primigenius*, or mammoth of the Siberian quaternary, is 3.42m. to the top of the head.

MINERALOGY AND PETROGRAPHY.[1]

Petrographical News.—In a late number of the *American Geologist*,[2] Messrs. Herrick, Clarke and Deming have a short article on some American norites and gabbros. Three rocks are described. The first is from Marshall Co., N. C., and is called olivine-norite. Its feldspathic constituent is labradorite, and its pyroxene is regarded as bronzite. The second—a porphyritic diorite, contains garnet and apatite. It is a facies of the norite. The Duluth gabbros are finally taken up and briefly described. In one phase of this rock the authors think they have found feldspar crystals, with a central core of labradorite, surrounded by a zone of orthoclase. Very little new is stated in regard to these rocks, except the view that the orthoclase-gabbros may be derived by the action of solutions (emanating from acid rocks) upon olivine-gabbro. The paper contains the statements of many important views, which, however, will not generally be accepted by petrographers unless substantiated by many more facts than the authors have been able to discover.—An instructive paper on some English tachylites is that by Mr. Cole in the *Quarterly Journal of the Geological Society*.[3] In it he describes a glassy basalt which exhibits all the stages in the transition from a glassy to the completely spherulitic forms so familiar among acid lavas. The spherulites are sometimes composed of an intergrowth of gray and brown fibres, which show the

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Maine.
[2] June, 1888, p. 339.
[3] May, 1888, p. 300.

strongest absorption in reversed position, the brown fibres becoming darker when their long axes are parallel to the short axes of the nicols, and the gray fibres when their transverse axes are parallel to this direction. As the result of his observations, Cole is inclined to regard variolite as a perlitic tachylite, whose perlitic cracks have been filled with secondary minerals.—Chelius[1] divides the dyke rocks cutting the eastern and the western areas of crystalline schists in Spessart and Odenwald as granite-porphyries and minettes in the latter area, and kersantites in the former. The kersantites are panidiomorphic aggregates of plagioclase and augite, together with hornblende, mica, quartz, apatite and a few rare minerals. The panidiomorphic structure passes into the holocrystalline porphyritic toward the edges of the dykes. The minettes of the Odenwald fall into two groups, the minettes proper, and the vogesites or minettes poor in mica. The latter embrace both augitic and hornblendic varieties. The minettes sometimes contain augite and sometimes biotite as their principal ingredient. The granite porphyries possess no peculiarity of structure or composition to which attention need be called.—The article on the Archæan Geology of Missouri, to a preliminary notice of which attention was directed in these pages a short time ago, has lately made its appearance.[2] In addition to the interesting observations already noted, it may be remarked that Mr. Haworth finds the nature of the plagioclase in the porphyrites from this region to be in no way connected with the presence or absence of quartz in the rocks. A more basic feldspar is sometimes found in a porphyrite containing free quartz, than in one in which no quartz is visible. The ground mass of a certain class of the porphyries resembles in structure the appearance known as pœcilitic. This is due to the inclusion of small particles of feldspar in quartz.—The elæolite-syenite[3] from the middle Transvaal, South Africa, consists of apatite, sphene, augite, hornblende, nepheline, feldspar, sodalite and zeolites in the order of their age. The porphyritic feldspar, probably anorthite, contains inclusions of all the older constituents. The augite occurs in two generations. The larger crystals have the optical properties of common augite, and contain a small percentage of alkalies. The mineral of the second generation is grouped into little bundles, and has the properties of acmite. It contains both alkalies and manganese. The nepheline is for the most part fresh; but in some cases has undergone alteration into zeolites.—A typical chlorite-schist has been discovered by Cathrein[4] at Gerlos, in the Tyrol. In a muscovite-quartz

[1] Neues Jahrb. f. Min., etc., 1888, ii., p. 67.

[2] Inaug. Disser., Johns Hopkins Univ., 1888, and Amer. Geologist, May and June, 1888.

[3] E. A. Wülfing. Neues Jahrb. f. Miner., 1888, ii., p. 16.

[4] Verh. d. k. k. Geol. Reichsanst.

background are porphyritic chlorite crystals with all the characteristics of chloritoid. Graphite, ankerite, zircon, tourmaline and rutile are the prominent accessory constituents. The rutile occurs as needles penetrating all the other minerals.—In an article on the bituminous rocks of Nullaberg, in Sweden, Törnebohm[1] gives the results of his examination of the bituminous matter existing in the archæan schists of that region. The locality has been known for some time, and is quite noted as having afforded data for arguments in favor of the existence of life in the globe during archæan time. The rock in which the organic matter occurs is a schist composed of microcline, chlorite, a little garnet and other accessory components. It is interstratified with gneiss, and is about fifteen metres in thickness. A part of the organic matter is in little lumps and irregularly shaped pieces, which are thought by the author to be original. It is sometimes entirely surrounded by microcline. Other bituminous substances fill cracks and cavities, which were probably produced in the rock by dynamic forces. This is younger in age than the rock itself, and was probably produced by the saturation of shattered rock by liquid hydrocarbons, which afterwards dried out, leaving a deposit of asphaltum.

Miscellaneous.—In connection with the article of Törnebohm, referred to above, it may be of interest to call attention to a recent article by Engler,[2] on the origin of petroleum. The experimental work of this chemist substantially re-enforces the theory which supposes petroleum to be the result of the distillation of the remains of marine animals at a low temperature and under pressure. Engler has obtained a series of oils, very similar in composition to the most prominent hydrocarbons of petroleum, by the destructive distillation of menhaden under a pressure of ten atmospheres, and at a temperature of 320°–400°.

ZOOLOGY.

Zoological News.—Porifera.—Vol. XXV. of the Challenger Reports is entirely devoted to the Tetractinellidæ, which are illustrated by forty-four plates. Professor Sollas classifies the Porifera as follows: Class (1) Megamastictora, containing the single sub-class Calcarea; and Class (2) Micromastictora, including

[1] Neues Jahrb. f. Min., etc., 1888, ii., p. 1.
[2] Ber. d. d. Chem. Gesell., 1888, p. 1816.

the three sub-classes Myxospongiæ, Hexactinellidæ, and Demospongiæ. The Demospongiæ he sub-divides into Tetractinellida and Monaxonida, the former comprising such Demospongiæ as have some or all of the scleres in the form of tetraxons, triænes, or desmas.

Cœlenterata.—The third of the reports composing Vol. XXIII. of the Challenger series is by Professor G. J. Allman, and forms the second part of his memoir of the Hydroida. Only three genera of Gymnoblastic hydroids: Stylactis, Eudendrium, and Monocaulos are represented in the Challenger collections. *M. imperator* is a most remarkable hydroid, having a stem seven feet long though but half an inch thick, and a stretch from tip to tip of tentacles of nine inches, so that all other hydroids sink into insignificance as regards size when compared with it. It was obtained at the depth of four miles beneath the surface. The Calyptoblastea were well represented in the collection. Idia, Lamoureux, proved on thorough examination to be constructed on a quite unique type, and a new genus, Perisiphonia, represented by two species, was discovered. In this genus the axial tube which bears the hydrothecæ is surrounded by numerous tubes set with tubular sarcothecæ, and the hydrothecæ projects through interstices in these axial tubes. The curious genus Synthecium is enriched with two new species, Thecocladium with one.

Professor Allman's system of classification does not allow those Hydromedusæ which have not yet been traced back to hydriform stocks, but which, from their resemblance to those that have been so traced, may be presumed to have been budded off from fixed trophosomes, to compose a separate group, but leaves them to find their right place in the future. His sub-orders are, therefore, (1) Gymnoblastea, in which the hydranths and gonophores are always naked, and in which the latter may be hedrioblasts or planoblasts, and the planoblasts are almost always Anthomedusæ, *i.e.*, have the generative elements developed in the walls of the manubrium. (2) Calyptoblastea, which have hydrothecæ and gonangia, and, when they produce planoblasts, have them in the form of Leptomedusæ, *i.e.*, with the generative elements developed along the line of the radial canals. (3) Eleuthero blastea, including the Hydra, with hydranth buds which become free. (4) Hydrocorallia, with a calcareous corallum permeated by cœnosarcal tubes from which the hydranths are developed. (5) Monopsea, including forms that are known to be developed directly from the egg. (6) Rhabdophora or Graptolites.

Vermes.—Vol. XXIII. of the Challenger series has a short report upon the Entozoa of the collection, by Dr. O. von Linstow.

Only sixteen species are described, ten of which are Nematodes and six Cestodes. The species obtained were chiefly from the alimentary tract of birds, and include four new forms of Ascaris, three of Filaria, one of Prothelmius, four of Tænia, and two of Tetrabothrium. The appendix mentions a large larval Echinorhynchus found in the abdomen of a Euphausia, two Distoma, and a Gordius found in a crab, so that the other groups of Helminths are not entirely absent from the collection.

Mollusca.—The report upon the Heteropoda of the Challenger collection, by E. A. Smith, although short, contains a most complete synonymic list of all known forms of the group. It is the fifth report in Vol. XXIII.

The first two memoirs of Vol. XXIII. of the Challenger Reports are by Dr. Paul Pelseneer, and treat of the Pteropoda Thecosomata, the Gymnosomata having been previously dealt with in Vol. XIX. The Thecosomata have a less highly organized alimentary canal than the Gymnosomata, and content themselves with humbler prey, feeding chiefly on Radiolaria, Foraminifera, Infusoria, and even on some of the lower Algæ. Specimens of the group were taken alive at seventy different stations, but no undescribed species were found. All the generic titles that have been given may be reduced to eight, viz.: Limacina, Peraclis, Clio, Cuvierina, Cavolinia, Cymbulia, Cymbuliopsis, gen. nov. and Gleba. The third part of the report treats of the anatomy of the Pteropoda generally. He considers the group, not as a class, but as a recent and specialized variation from the Gastropod type. He places them among the Pectinibranchiate Oplsthobranchs, and traces the Thecosomata to the Bulloidea, and the Gymnosomata to the Aplysioidea.

Crustacea.—Vol. XXIV. of the Challenger Reports is occupied with the report of C. Spence Bate, F.R.S., on the Crustacea Macrura. Though styled one volume, it is in fact two goodly tomes, the one containing 1030 pages of text, the other 157 lithographic plates. Not only are generic and specific diagnoses given with minuteness, but all that is known of the developmental stages (in which direction there is still much work to be done) is reproduced. Bate follows Dana in placing the Penæidea in a separate division, which he names Dendrobranchiata, and he considers the Schizopoda or Stomapoda as forming an aberrant branch of the Dendrobranchiata, more nearly allied to the degraded forms of the Penæidea than to those of any other group. He asserts that, "with the exception of the pereiopoda, the several genera do not possess a single character that is not held in common with some genus of the Macrura," divides the Macrura into the two principal

divisions of Trichobranchiata and Phyllobranchiata, with the Dendrobranchiata (Penæidea and Sergestidæ), intercalated. Each of these divisions is divided into two sections, the Normalia and the Aberrantia. The family Galethæidæ belongs among the Trichobranchiata Aberrantia, while the rest of the old group Anomoura form the Aberrantia of the Phyllobranchiate section. These groups will form the subject of a report by Professor John R. Henderson.

Recent works upon lacustrine faunas have shown that copepods, and especially those of the genus Diaptomus, are both more numerous in species and more widely distributed than is generally supposed. Most of the ordinary types have been confounded under the name of *Diaptomus castor*, so that until now it has not been possible to speak with any approach to certainty of the geographical distribution of any species. M.M. de Guerne and Richard have now, thanks to the numerous documents they have studied on the subject, given a map of the distribution of Diaptomus, and proved that it may be regarded as a cosmopolitan genus.

ENTOMOLOGY.[1]

Entomology for Beginners.—The most important Entomological event of the past month is the appearance of an elementary text-book by Dr. Packard.[2] The following review of this work has been prepared by a prominent Entomologist at our request.—*J. H. C.*

Dr. Packard's Entomology for Beginners fills a niche which has long been vacant, and supplies a need which has been so pressing, particularly of late years, that it will be and should be warmly welcomed; and wherever imperfections may be noticed by the critical reader, these should not make him forget that Dr. Packard has, in writing this book, given us really the first treatise of its class in the English language. We find after careful reading that an astonishing amount of information has been crowded into its three hundred odd pages, and that the plan of the work is on the whole satisfactory. The author has in his preface outlined his ideas as to the probable usefulness of the work with sufficient

[1] This Department is edited by Prof. J. H. Comstock, Cornell University, Ithaca, N. Y., to whom communications, books for notice, etc., should be sent.

[2] Entomology for Beginners, by Dr. A. S. Packard, M.D., Ph.D., New York. Henry Holt & Co. 1888.

modesty, and, placing ourselves in the attitude of the first two classes of his probable readers, namely the beginners and the amateurs or dilettante entomologists, we find that we have little of which to complain. The first class of readers, however, whom he hopes to reach, the farmer, the fruit-grower, and the gardener, the book will hardly satisfy as a hand-book. No one, however, can write a book on this subject for farmers unless he is a farmer himself.

While our first impression was that Dr. Packard had made a mistake in adopting in this elementary work the division of the class into sixteen orders, our maturer opinion coincides with his own judgment. Brauer's classification, or some slight modification of it, is bound to be generally adopted. The sooner this is brought about the better, and in no way could a ready adoption be more speedily achieved than by teaching the system to younger entomologists, and to beginners in the study. Dr. Packard's substitution of *Plectoptera* and *Mecaptera* for *Ephemeridæ* and *Panorpatæ* is, of course, done in the interest of uniformity, but we regret his apparent slip in the etymology of his word *Mecaptera*. This leads us naturally to criticise the glossary, in that for less than half of the words defined is the derivation given. The same incompleteness is seen in the acknowledgments of illustrations. Credit for many is given, but many others are unacknowledged, leaving the erroneous impression that all the latter are original with the book.

We are somewhat disappointed with the chapter on collecting, preserving, and rearing. Although most of the published notes have been brought together, the chapter is too much a clipped one, and many well-known points unpublished are omitted. For example, Prof. Riley's description of his breeding-cage, published no less than fifteen years ago, is reproduced with its accompanying figure, while no word is said of the later improvements which Prof. Riley and others are using, and with which the author was familiar. Similarly, in the matter of inflating larvæ, no mention is made of the tin ovens generally used, or of the method recently described of inflating several larvæ simultaneously.

The short family characterizations given in small type will be useful in many instances, but it seems to us a mistake, and a certain discouragement to the student, to insert such definitions as those given on page 126, under the Diptera, viz.:—

Family Asteidæ.—Front bristle above.

Family Phytomyzidæ.—Front bristly.

Family Agromyzidæ.—Front with strong bristles.

It also seems to us that in a work of this character strict uniformity in sub-family terminations should have been followed, whether previously adopted by other authors or not.

But we have found enough fault. We anticipate that the book

will do a great deal of good. Many teachers, we know, will heave a sigh of relief upon seeing it, and we have no doubt but that its sales will be gratifying both to the author and to the clear-sighted publishers.

An Introduction to Entomology.—By the time this number of the Naturalist reaches its readers, the first half of an elementary text-book of Entomology, prepared by the editor of this department, will have been published.[1] This part includes the grammar of the science, and half of the systematic part. It contains many original illustrations, drawn and engraved by Mrs. Comstock. The following extract from the preface of this work will indicate the author's plan of treatment of the subject:

"This work has been prepared to meet the demand for a text-book which shall enable students to acquire a thorough knowledge of the elementary principles of Entomology, and to classify insects by means of analytical keys similar to those used in Botany. By means of the keys the student can readily determine to what family any insect of which he has a specimen belongs. In many cases tables of genera are also given, and the more common or conspicuous species in each family have been described.

"Although much pains has been taken to render easy the classification of specimens, an effort has been made to give the mere determination of the names of insects a very subordinate place. The groups of insects have been fully characterized, so that their relative affinities may be learned, and much space has been given to accounts of the habits and transformations of the forms described. As the needs of agricultural students have been kept constantly in view, those species that are of economic importance have been described as fully as practicable, and particular attention has been given to descriptions of the methods of destroying those that are noxious, or of preventing their ravages.

"The pronunciation of the technical terms has been indicated by marking the accented vowel, and at the same time indicating its length *when the term is pronounced as an English word.*"

Synopsis of North American Diptera.—All North American students of Entomology will welcome the work just published by Dr. Williston.[2] This work consists chiefly of analytical keys and characterizations of families. There is an introduc-

[1] An Introduction to Entomology, by John Henry Comstock, Professor of Entomology in Cornell University, and formerly United States Entomologist. Published by the author, Ithaca, N. Y. Part I. $2.00.

[2] Synopsis of the families and genera of North American Diptera, with Bibliography and new species, 1878–1888, by Samuel W. Williston. 8vo., pp. 84. New Haven, J. T. Hataway. $1.00.

tion, in which the terminology of Diptera is given; then follows an analytical table of families, and, except in the case of the Nematocera and Muscidæ, tables of genera are also given. There is appended to the work a Bibliography of the species described since the publication of Osten Sacken's catalogue. The whole forms a very convenient manual, and it cannot fail to stimulate the study of this much neglected order.

EMBRYOLOGY.[1]

Notes on the Development of Holothuria.—The following interesting facts are taken from a note, not intended for publication, which was addressed to Prof. W. K. Brooks from Mr. Charles L. Edwards, who has been investigating the development of *Holuthuria* at Green Turtle Key, Bahama Islands. As they refer to a type with an abbreviated development within the egg, it has been considered desirable to reproduce them.

"I tried artificial fecundation for some time without result. Then putting males and females together in a tub I could get no fertilized eggs. Finally, about two weeks ago (Aug. 1st), I arranged a live box, as recommended by Selenka, and with excellent results. I have since had no trouble in gathering fertilized eggs and upon four occasions. These Holothurians prove very interesting. The egg is quite opaque, but I have made out the following general conclusions from surface views, but as I have not yet had the eggs just at fertilization, for the animals do not generally discharge the eggs until five or six hours after being put into the box, I have not the exact age of the stages.

"The segmentation is regular and is completed in about seven or eight hours. The blastosphere is formed in about twelve hours. Then gastrulation takes place. Then follows a very complex development within the egg-shell. To all appearances the embryo passes through the Auricularia stage of free-swimming Holothurian larvæ. It then takes the form of the adult, develops five oral tentacles, and so formed, bursts forth from the shell about the fifth day and creeps about on the bottom of the dish. It has developed the beginnings of the spines in the egg, and these with tentacles now grow rapidly during the free larval state. On the sixth day a tentacle arises at the posterior end which grows rapidly, until on the eighth day it is longer than the oral tentacles. About this time a favorite attitude of the larva is to erect itself on the posterior

[1] Edited by Prof. Jno. A. Ryder, Univ. of Penna., Philadelphia.

tentacle, or more properly, I suspect, ambulacral foot, and wave the oral tentacles about. Of course this attitude is not held long, the creeping position, using all the tentacles or feet being most usual. On the eleventh day a seventh tentacle, and on the fourteenth an eighth tentacle appears; the former from about the middle of the ventral surface, and the latter at the base of the oral tentacles on the ventral side. In the meantime the spines have been getting longer and their bases branching in various rosette forms. I now have several larvæ fifteen days old getting along nicely, and from the four lots of eggs have saved forty-three vials of embryos, and so will probably get a complete series, as each set were no doubt fertilized at different times of the day and in any one lot the individuals do not develop evenly.

"These embryos seem to be intermediate between Kowalevsky's, where the adult state is attained without a metamorphosis, and the one described by Selenka. Of course I cannot tell what goes on inside the shell those four or five days after gastrulation and before the larvæ develops tentacles, as the egg is so very opaque. I should have said also that at first the eggs are brown, in a few days they show green pigment spots, and these increase until the free larva is quite green.

"In two or three weeks I shall probably have an abundance of material for sectioning and then I want to take in hand the case of the brown *Clypeaster*, common about here. I am getting fond of the study of the Echinoderms and shall work on them as I get opportunity.

"We came across the birth of an extraordinary zoological myth out here a few weeks since. One of the leading citizens, who is also the school-master, had made a discovery. Whereas they had always thought that the sea-stars come from the sand or from the big stars up above, now they had found the real source 'for true' as they put it. They told us of it and we thought we should be able to surprise the world with a borrowed discovery! But alas! they took us down to the shoal, broke open the *sand-dollars* and pulling out 'the creature' showed us the wonder—*their* young sea-star! They supposed that this young sea-star stayed in these old shells until grown and could hardly believe us when we told them that it was a live *Clypeaster!*"—*C. L. E.*

ARCHÆOLOGY AND ANTHROPOLOGY.[1]

The American Association for the Advancement of Science held its thirty-seventh annual meeting at Cleveland, Ohio, August 15th to 21st, 1888. The meetings were held in the Central High School, which, though some distance from the hotels, had good street-car communications. The building was admirably suited to the needs of the Association. The rooms were ample both in number and size, while the auditorium, large enough for all general meetings, could be darkened for afternoon lectures with lantern views.

The citizens of Cleveland took great interest in the meetings and the local committee made every arrangement possible for the comfort and convenience of visitors. The ladies in charge of entertainments, receptions, etc., devoted themselves to these duties during the entire week and wei eminently successful in everything they undertook. Lunch was provided daily in the basement of the building. Thursday afternoon was devoted to receptions given by the citizens at their homes, and some of the magnificent and luxurious residences on Euclid Avenue were thrown open and the members of the Association hospitably received.

SECTION H.—ANTHROPOLOGY.

Dr. C. C. Abbott, of Trenton, N. J., was president of this section, with Dr. Frank Baker, of Washington, D. C., secretary. The meetings were well attended and much interest was shown in the proceedings. The section was kept busy with the reading of the thirty-two papers and their consequent discussion, closing only late in the afternoon of the last day. The session of Wednesday, August 15th, opening day, was devoted to the presidential address, "Evidences of the Antiquity of Man in Eastern North America." Dr. Abbott reviewed the discoveries of paleolithic implements made on this continent, devoting himself principally to those made at Trenton, N. J., by himself; at Little Falls, Minnesota, by Miss Franc E. Babbitt in 1875; and in the Valley of the Little Miami at Loveland, Ohio, by Dr. C. F. Metz in 1886, and the continuation thereof down to the present summer by himself and Mr. Wilson. The finding of the obsidian spear point by Prof. W. J. McGee in the quarternary deposits of Lake Lahontan, Nevada, was also noticed. He concluded from the evidence, first, that paleolithic man did not become extinct, and second, that his descendants attained an advanced

[1] This department is edited by Thomas Wilson, Esq., Smithsonian Institution, Washington, D. C.

degree of culture in the land of their forefathers. "We might maintain that we have his descendants in the Eskimo, and that they were finally driven north by the Indian, who, as is conceded by all students, migrated hither at a period, which, archæologically considered, was not exceedingly remote."

He devoted a portion of his address to a consideration of the date of the paleolithic period in America, and cites Rev. G. F. Wright of Oberlin, Ohio, thus: "To say that man was here before the close of the glacial period only fixes a minimum point as to his antiquity. How long he may have been here previous to that, must be determined by other considerations. The term 'close of the glacial period' is itself an indefinite expression. The glacial period was a long time in closing, theerosion of the Niagara gorge began at a time long subsequent to the deposit of gravel at Trenton and at Madisonville. Between these two events a sufficient time must have elapsed for the ice-front to have receded a hundred miles or more, or all the distance from New York to Albany, since only at that stage of its retreat could the Niagara river begin its work. The deposits at Trenton and Madisonville took place while the ice-sheet still lingered in the southern water-shed of New York, Pennsylvania and Ohio." Dr. Abbott concludes, "There was a time when, to all appearances, American Archæology would have to be squeezed into the crammed quarters of ten thousand years; but we are now pretty sure of twenty or even thirty thousand years in which to spread out in proper sequence and without confusion, the long train of human activities that happened during prehistoric time. If we accept the most moderate estimate of the length of postglacial time, some 6,000 years, we have an interglacial time (that is, between the first and second epochs) from 18,000 to 60,000 years, and to this must be added the long stretch of time during which the second epoch of cold continued. Assuming that geologists have made no mistake, archæology has time enough and to spare. At no period was the continent uninhabitable, however thick or wide-reaching the ice, or deeply submerged the lower lying areas. There was still land enough for all the mammalian life of that period, and it flourished at the foot of the advancing ice-sheet and re-entered every track as the glaciers withdrew. In that time we had the mastodon and mammoth, reindeer and bison, musk-ox and moose, and the man of that period was familiar with them all."

A general session of the Association was held in the evening to hear the retiring president, Prof. S. P. Langley, Secretary of the Smithsonian Institution, deliver his address, entitled, "The History of a Doctrine." The "Doctrine" was that of Radiant Heat or Energy. This address was profound and very learned, and yet by his incisive style of writing and dignified delivery, the Professor made it easily

understood by a popular audience. It is published in *Science* for August 17.

Thursday, August 16th.—"Certain prehistoric ornaments found in Mississippi," by Prof. R. B. Fulton, of the University of the Mississippi. He presented about thirty prehistoric beads from Lincoln county, Mississippi. The material was jasper, reddish-brown, mottled with a lighter shade and very hard. Their forms were cylindrical, and also of the shape of deer and birds. They were all, or nearly all, polished and drilled. Prof. Fulton said he had never seen any similar beads except those in the Smithsonian exhibit now open at the Centennial Exposition at Cincinnati. Mr. Wilson said he had prepared that display and had chosen those from the many in the National Museum to show a series descriptive of the method and work of the drilling of these hard substances by the prehistoric man.

Dr. Frank Boas, the editor of *Science*, New York city, delivered a learned address on the "Development of the Civilization of Northwest America." He raised a query as to the possibility of establishing a connection between Asiatic and American tribes, and noted many indications of relationship, and said the Indian tribes of the northwest coast of America far excel their neighbors in arts and industries. The tribes of the northwest coast belonged to many linguistic stocks. In British Columbia alone were eight distinct tongues. He spoke of the striking similarity of physique between certain tribes of the northwest coast with certain Asiatic tribes. The customs and legends of these tribes were much alike, but in their myths the speaker found the greatest coincidence. His paper, though replete with facts, was but little more than the announcement of his theory, and he closed as follows: "But before drawing further conclusions we must analyze the civilization of northwest America in order that we may know what we have to compare. Only after this is done can a study of the numerous striking analogies be successful in demonstrating the Asiatic origin of these northwest tribes."

This speaker used the term nation as synonymous with people, and civilization as synonymous with culture, to which Major Powell took exception.

The Rev. W. H. Beauchamp, of Baldwinsville, N. Y., read a paper, "The Onondagas of To-day." This was almost a complete history of this tribe as it exists at present, and has existed during the present century. They now number about four hundred. They have forgotten their own earlier history, and their traditions are uncertain, contradictory, and valueless as history. Illustrations of this were given by the dozen.

The speaker gave his own recollections of the Onondagas and of their manners and customs during fifty years past. He described

their feasts, their marriages, their wampum, their amusements, and their modes of life.

Dr. D. G. Brinton read a paper on "The Alleged Mongolian Affinities of the American Race," in which he demonstrated that no such affinities existed. His conclusion was the opposite of that of Dr. Boas. An abstract is as follows:

Many recent writers assert that the American or Red race presents various traits which bring it into close relationship with the Mongolian. These alleged resemblances may be classed as either of language, of culture, or of physical appearance. In language the Eskimo has been said to resemble Ural-Altaic tongues of northern Asia; and the Otomi of Mexico has been asserted to be monosyllabic and isolating like the Chinese. Both these statements are proved erroneous by recent researches. The American languages differ entirely from any of the Mongolian group.

In culture there are various similarities but not more, and not other, than can be pointed out between any two groups of early civilizations, and no one of them is evidence of intercourse.

The physical similarities relied upon begin with the color of the skin. But no American tribe shows the peculiar hue of the Mongol. The hair, though straight in both races, differs in color and to some extent in shape of cross section. The oblique or "Chinese" eye is by no means usual in the American race, scarcely more so than among the whites, and is, moreover, of much less importance than has been maintained. The shape of the skull is markedly different. The Mongolian head is round, that of the Eskimo is notably long, and of other tribes mixed. The nasal index of the American Indian approaches that of the modern European much closer than it does the Mongolian. There is in certain tribes some general physiognomical resemblance, and this is all upon which can be based the alleged Mongolian affinities of the American race; and this is of but slight importance.

The discussion on this paper was most animated, although it almost immediately left the subject.

Prof. E. S. Morse, of Salem, Mass., supported the speaker. Mr. Horatio Hale, of Toronto, made some observations, as did Prof. Mason. Major Powell dilated upon the importance of language, and told how it alone was the true test of racial affinity. He described man in the paleolithic period as having spread over and occupied almost the entire world; he said the evidence of his existence and occupation were certainly to be found on every continent. And he described the formation of language by the man of the paleolithic period. He showed how different modes of speech were begun and different dialects grew. He asserted the tendency of man to be, to consolidate and reduce the number of his languages rather than to divide and extend them.

Prof. Morse said this would make a different language for every fish-pond around which the prehistoric man assembled, and denied the value of language in determining racial affinities in prehistoric times.

Major Powell answered by declaring his theory of language as a racial test had no application to man earlier than we had knowledge of his language.

Dr. Brinton sought to close the discussion by saying that different races might employ the same language, and that according to his theory, Major Powell could prove, what we know from history and from our senses to be an absurdity, to wit: that because they spoke the same language, the white and the black man now occupying the United States belonged to the same race.

Major Powell had the final word to say that his opponents had constructed a man of straw that they might enjoy the pleasure of thrashing him. His own position was, that in the beginning all men sprang from the same stock, or if not, they at least found themselves in the same condition; that there were then no distinct or separate races of men, and that the divisions and subdivisions of race, blood, language, culture or physique had been accomplished little by little, and they had thus finally developed into the different races with their different languages and cultures. But that they still all shaded off into each other and ran together; and, whether counted sideways through the collateral branches in the present day, or counted backwards, each through his own ancestors, it was impossible to find an exact dividing line between races. So all the world was now, as it ever had been, akin, of one race and one blood; and that the subdivisions into races was but arbitrary; the work of man and not of God.

This discussion was the most impetuous and interesting of any in the section. The speakers were able, ardent, fluent, and at times, Major Powell especially, arose to eloquence.

Mr. Hilborne T. Cresson was down for two papers, but he was absent and they were read by abstract. They related to his discovery of two paleolithic implements found by him in what he calls modified drift, one on the east fork of White river, Jackson county, Indiana, and the other in the Trenton gravels, but on the Pennsylvania side of the Delaware river. Cuts of the implements were shown but the implements themselves were not present.

Friday, August 17th.—Colonel Garrick Mallery, of the Bureau of Ethnology, Washington, D. C., read a paper entitled "Recent Discovered Algonkin Pictographs." Colonel Mallery has been engaged for ten years in the investigation of the sign language of the North American Indian, and is the highest authority on the subject. Colonel Mallery has just returned from a month's visit among the Micmacs of Nova

Scotia and around the Bay of Fundy. He had discovered many new pictographs, tracings of which he had taken and presented to the audience. The lecture-room was decorated with these and other specimens in a manner highly interesting. Colonel Mallery told of the investigations and discoveries made by himself and Dr. W. J. Hoffman, and of their comparisons of the real objects with the descriptions made by Schoolcraft in his voluminous publications issued in 1853, and showed that he (S.) had fairly represented the substance, but sometimes with exaggeration. The principal part of Colonel Mallery's paper was devoted to a description of the signs and symbols which were on the charts, and to a translation of their messages.

Remarks were made by several persons commendatory of Colonel Mallery's labors. Prof. Mason said: "We have before us to-day a record of the beginning of a written language. We are standing in the presence of the birth of literature." And he asked a vote of thanks to Colonel Mallery.

Prof. J. E. Todd, of Tabor, Iowa, presented the next paper, entitled "Some Ancient Diggings in Nebraska," which he illustrated by a sketch upon the blackboard. These were at Newawka on the Weeping Water creek. They were supposed to be pits dug for the extraction of flint. They bore some resemblance to the quarry at Flint Ridge, Ohio.

Dr. D. G. Brinton presented "Early Man in Spain." He dealt first with the chipped flints discovered by Ribera at Otta, which were believed to come from the miocene. He said the implements of the neolithic period in Spain have a striking similarity in size and form with those common to the United States.

The Basques are the most ancient known inhabitants of Spain and Portugal. They are believed to have lived there at the time of the formation of the shell-heaps, which seem older here than in Denmark. The Basque language has many peculiarities of the typical American Indian tongue, such as the Algonkin. Dr. Brinton exhibited a map on which the six hundred fathom line of the Atlantic ocean was indicated. An upheaval of the land to that altitude would join the continent of Europe with that of North America by way of England, Scotland, the Faroë Islands, Iceland, Labrador, and the New England coast. Many things seem to confirm this theory, which is an opinion held by many geologists. The existence of this land-bridge across the Atlantic ocean once established, many ethnologic problems relating to the American Indian would be at once solved.

Mr. Wilson complimented Dr. Brinton upon his paper and continued in the same line. Speaking of the endurance of languages he said the Basque language was still spoken in France and Spain, and there were many persons now living there in the retired rural

districts who could speak no other. The aged couple who occupied the house at the entrance of the cavern of Laugerie Basse, excavated by M. Massanet, speak only the Basque language, and any one visiting there must take with him an interpreter who speaks French and Basque.

On the other hand, the language of the Normans, who came as invaders and settled permanently in that province in the north of France which bears their name, had entirely died out. It never established itself as a separate language, but joining itself to the French made a dialect, a bastard language, which was neither the one nor the other. The Gallic language brought from Wales or Cornwall into Brittany had survived side by side with the French and continued as a separate language in spite of all efforts of the government to root it out. It was now a law of France that none of these ancient languages, at once foreign and indigenous to France, shall be taught in the public schools.

Mr. Wilson described the dolmens, menhirs, and other monuments of Spain and France and told something of the efforts made to rescue and preserve them.

Mrs. Anita Newcomb McGee, wife of Prof. McGee, of Washington, D. C., read the paper of the afternoon, entitled "American Communities." This lady had one of the largest audiences of the entire meeting. She was listened to with close attention and received many congratulations. She described in detail with the necessary statistics, the seven principal communistic societies which had been established during the past century in the United States. Her arguments were fairly made and her deductions correct. She did not undervalue a benefit, nor overstate an objection, yet she said she was forced to the conclusion that communism could not permanently rival independent competition. She closed with three fundamental objections to, or causes for failure of communities.

1. A community does not admit that wide differentiation of labor and variety of occupation which is found outside, and is considered a sign of progress.

2. A community is an institution intermediate between the individual and the State, and is antagonistic to that other more natural intermediate institution—the family. This has been felt by community founders, and they have tried three methods of disposing of the family. *A.* Abolishing it by celibacy. The climax is here rapidly reached, and after, it is impossible to prevent a steady decrease in numbers. *B.* Abolishing it by complex marriage. This is a logical settlement of the rivalry between community and family, *i.e.*, making the two one, but it so pronounced a return to conditions long abandoned in the course of evolution, that later or monogamic instincts (now normal) refuse to be suppressed, and finally cause the failure of this attempted solution. *C.* The reten-

tion of the family, which means one community within another. Each person has then two interests to serve, and in the often necessary choice between them, he cares for his own family, even though it be sometimes to the detriment of the higher circle—the community.

3. The essential object and aim of Communist and Socialist alike, is equally to support and reward the worthy and unworthy, the practical effect of which is to suppress all stimulus to labor, and to reduce all men as far as possible to a dead level of mediocrity.

That form of social organization, however, which tends to produce the ablest men and stimulate them to highest efforts must, other things equal, make the greatest progress in social evolution. Communism is satisfied with mediocrity, and here is its weakness. On the other hand its strength lies in its unity of interests—that is, in its element of co-operation.

Saturday was devoted to an excursion given by the local committee to members of the Association. The steamer "City of Cleveland" left her dock at 8 A.M. well filled with passengers. Her first stop was at Kelly Island, where, under the guidance of Prof. Foote and Mr. Severance, the visitors were conducted to the great glacial groovings in the solid rock which had been exposed to view for the purpose of this visit. The steamer then continued to Put-in-Bay. Everything possible was done by the committee to make it a day of pleasure. The day was superb and the lake smooth as glass. Concerts were given on board, and amusements, scientific and dexterous, were the order in the smoking-room. The steamer returned at sundown.

Monday, August 20th.—Mr. A. Wanner, of York, Penna., Principal of the High School, exhibited some unfinished banner stones from the Susquehanna river, and read a description of the methods by which they were made, which is being prepared for publication in the NATURALIST.

Horatio Hale, Esq., of Clinton, Ontario, read an elaborate paper, subject, "The Aryan Race, Its Origin and Character," which is being published in *extenso.*

Mr. J. W. Smith exhibited some mound-builder relics from Iowa.

Prof. F. W. Putnam described the Serpent Mound of Adams county, Ohio, and its surroundings. This lecture was delivered in the auditorium and was accompanied by photographs of the mound, showing its restorations and the various explorations in its immediate neighborhood by means of lantern views projected upon the screen.

Prof. Wm. Libbey, Jr., of Princeton College, described "Some of the Characteristics of the Yakutal Indians of Alaska." He compared the strength of the men who spent their time in hunting and fishing and amusements with that of the women who did all

the labor. He mentioned their aptness in mechanical arts and their strict idea of property. They were highly superstitious and did many things to secure good fortune. A whole tribe would get baptized by the missionary in order to change their luck, and when their luck did not change the missionary had to. Their numbers were diminishing, but this was due principally to changes in diet and clothing, for in that climate the canned beef and cotton over-alls of the white proved but poor substitutes for seal-fat on the inside and sealskin without.

Dr. D. G. Brinton, of Media, Penna., described some "Traits of Primitive Speech." His abstract was as follows:

Language was not born in a day. Primitive utterance was of course not the same everywhere. By studying languages which have suffered least by contact with others we can catch some glimpses of the character of man's earliest significant utterances. I begin with some observations on the phonetic elements. In all European tongues the mere letters of the alphabet have no meaning. Their value in a word is fixed. Arranged in a word they convey its sound and sense. Judging by certain American examples this was not the case in primitive speech. In referring to the Tinne language Bishop Farrand asserts that in primitive speech "a" expressed matter, "e" existence, "i" force or energy, "o" existence doubtful and "u" existence absent. These vowels were put in action by single or double consonants. These consonantal sounds were sixty-three in number. The labials expressed the idea of time and space, the dentals the termination of force, the nasals motion in repetition, the gutterals motion in curves, the "h" ideas of command. The Cree language, to quote from the same authority, resembles the Tinne no more closely than does the French the Chinese. Nevertheless, the same peculiarity of materially significant phonetic elements is discovered. I find but little, yet some, evidence in the different groups of American tongues in favor of the theory which maintains that there is some fixed relation between sound and sense in the radicals of languages. "N" expresses the notion of the *ego*, or myselfness in many languages. "K" is associated with the idea of otherness. In many American languages the phonetic elements are vague and fluctuating. In referring to the Klamath language Dr. Behrend writes: "The same person pronounces the same word differently and when his attention is called to it he will insist that it is the same." Some of the consonantal sounds are not true elementary sounds, but in primitive languages had to have some other consonant associated with them. Phonetic elements were often inadequate to express the idea. In the Indian languages, emphasis, action, and modification of the vocal expressions seem to have constituted an essential part. The stress laid on a vowel sound often alters its meaning. In the domain of lexicography,

primitive speech presents a very curious phenomenon. In Tinne the same word may express good or bad, high or low. In Cree the union of opposite significations reappear in the ultimate rudiments of the language and numerous series of opposite ideas are developments from the same original sounds. The gradual development of grammar is strikingly illustrated in these languages. Subject, verb, direct object and remote object were all expressed in one word. Primitive words expressed being in relation, and hence partake of the nature of verbs. Primitive man did not connect his sentences. They followed one another disjointedly. Relative pronoun and conjunction are absent in American languages. Few American tongues have adjectives. The question has arisen did primitive man model his sounds after what he heard or what he saw? The former opinion has been most popular. His earliest sounds seem to have been expressive of motion and rest, energy and its absence, space and direction, color, form, and the like.

Tuesday, August 21st.—Horatio Hale, Esq., read a paper on "An International Language," for scientific and other purposes. In this he dissected the Volapük and showed its many errors. He advocated a language founded upon a more scientific basis. His paper is published in *The Critic*, N. Y., of August 25.

Mr. Wilson doubted the success of the experiment and expressed his belief that no new language could be impressed upon the people by any vote or decree however authoritative. He cited the persistency of the Basque and Gallic languages in France and the many dialects extending over all Europe; and this in spite of all efforts to uproot or consolidate them. He thought a common language might be established between the people of different countries by the different governments uniting in the choice of a language (one of the living ones), to be taught in the schools of the country. We Americans could adduce many arguments why English should be chosen as the common language. But suppose the governments should be unable to agree upon it and German should be chosen. Then in all English-speaking countries there would be taught in the public schools English *and German;* in France, French *and German;* in Italy, Italian *and German;* in Spain, Spanish *and German*, and so on. Thus every one would be able to speak his own language and a common language which every other person of whatever nationality would also be able to speak.

Prof. MacFarlane elaborated with approval Mr. Hale's method, and commented upon the defects of Volapük. The discussion was continued by Prof. Mason and Dr. Brinton.

To be continued.

MICROSCOPY.[1]

The Eggs of Amphibia.—I have found *hypochlorite of sodium* an excellent solvent for the gelatinous envelope of the amphibian egg. I obtained a ten per cent. solution, and diluted it with five or six times its volume of water. The eggs are first hardened by heating, or by immersion in some preservative fluid; then placed in the Labarraque solution until the gelatinous envelopes are so far dissolved that the eggs may be easily shaken free. They are then washed and preserved in alcohol. This method works perfectly with the eggs of Necturus, and has given equally good results with the eggs of the frog. The time required for dissolving the envelope in the case of Necturus is about five minutes. Care should of course be taken not to leave the eggs exposed to the solvent longer than is necessary in order to destroy the envelope.

Experiments with Chitin Solvents by T. H. Morgan.[2]—The first experiments were made upon the eggs of the common cockroach, and the selection turned out to be a most fortunate one. A great many eggs are laid at one time, the whole number being surrounded by a stiff chitinous coat, forming the so-called raft.

The solvents used were the *hypochlorites of sodium* and *potassium*, recommended by Dr. Looss in 1885.

The most successful experiments on the cockroach's eggs were as follows:

1. The rafts were placed, in a fresh condition, in a weak solution of *eau de Labarraque* (commercial fluid diluted with five or six times its volume of water), and left until the chitinous envelope became soft and transparent. The time varies; if *slightly warmed* the time is less, for the warm solution perhaps thirty minutes to one hour; but one must go more by the appearance of the chitin than by any definite time. If the embryos are far advanced they may now be removed from the envelope one by one; if still young, they had better be hardened and cut altogether. In both cases the eggs or embryos were next washed for a few minutes in water, and then transferred for an hour to picro-sulphuric acid, then as usual they are passed through the grades of alcohol, 70 per cent., 80 per cent., 95 per cent.

[1] Edited by C. O. Whitman, Director of the Lake Laboratory, Milwaukee.

[2] Studies from the Biological Laboratory, Johns Hopkins University, Vol. iv., No. 4, p. 217, 1888.

2. To specimens which have been already hardened and preserved the solvent may also be applied; but in all cases where fresh material is easily obtainable, it should immediately have its chitin softened and then afterwards be preserved. Here the method is somewhat shorter, since the substance has been previously hardened. From alcohol—weak solution—they are put into the Labarraque and softened as above, then passed through water and the alcohols, etc.

In most cases in which an animal egg or embryo is encased in chitin, the best results have been obtained by staining the sections after they have been cut and fixed to the slide. If the specimen is small, staining *in toto*—after having the chitin softened, or if before this has taken place, after having made an entrance through the chitin with a point of a needle—is equally good. The greatest difficulty, and practically the only one which one meets with, is that the Labarraque solution not only attacks the chitin itself, but after a time the soft tissues of the animal—apparently the connective tissue. Where the chitin surrounds the object completely, as in the case with the roach's raft, one can remove the object from the solution as soon as the chitin is softened, and before the underlying parts have been attacked. In cases like this the solvent is at its best.

Very often, however, the soft tissues of the animal are exposed in places between the chitin covering. This is well illustrated by the joints of insects' legs, etc., and very frequently these exposed places are attacked before the chitin is completely softened, thus causing the joints, if much handled, to fall apart.

By judiciously diluting the solution and taking the parts to be softened from it before the joints are attacked, one will find its application practicable even here.

The greatest difficulty of all is when the chitin is internal, completely surrounded by soft tissue. So far as I have made any experiments here, I find that one gets better results with very dilute solutions—diluted from eight to ten times, or even more. It must be admitted that in this last case the application of the solvent is more doubtful, and of not nearly so much service as in the first and second supposed cases.

Strong solutions, then, had better be used only when the chitin completely surrounds the soft animal parts, and dilute solutions must be used in all cases where these latter substances are exposed. The solution not only softens the chitin, but *removes all pigment* either in the chitin or in the tissue beneath, and this is at times advantageous.

THE USE OF CELLOIDIN IN MAKING DEMONSTRATION-PREPA-

rations of the Brain.[1]—Methods of making dry preparations of the brain for purposes of demonstration have been recommended by Giacomini, Laskowski, Broca, Duval, Schwalbe, and others. The method employed by Dr. Lenhossék of Budapest differs from all these, as the preparations are to be kept in alcohol, except when used for demonstration. For this purpose, they are removed from the alcohol and carefully dried in soft linen. They bear handling well, and are not injured by an exposure of two hours. They begin to shrink, however, if not returned to the alcohol after the lapse of this time.

Preparation.—1. Alcohol supplies the best means of hardening, as it well preserves the color and form. If other reagents are employed, such as zinc chloride, Müller's fluid, etc., the preparation must lie in alcohol awhile before further treatment.

2. The hardened preparation is removed from the alcohol, made dry superficially by careful application of soft linen, and then coated with a thin layer of celloidin, applied with a fine brush. The celloidin is dissolved in a mixture of equal parts of strong alcohol and ether, as for imbedding. The furrows are not to be filled with the celloidin solution, but the walls must be carefully and thoroughly painted. In order to keep them open during the process of hardening, it is well to fill them with cotton or with blotting-paper.

Within five or ten minutes the celloidin dries to a thin, transparent, tough membrane, which protects the preparation and gives it greater firmness.

Dry Preparations of the Brain.—The method of impregnating the brain with paraffine was first employed by Fredericq,[2] in 1876. Schwalbe[3] adopts essentially the same method for the human brain, proceeding as follows:

1. Hardened in zinc chloride or in alcohol.

2. After removing the membranes, cut into a number of suitable pieces, as it is not advisable to impregnate the brain *in toto.*

3. After dehydrating in 96 to 97 per cent. alcohol, soak in turpentine until completely saturated.

4. Impregnate with soft paraffine, kept at 60°C. (five to eight days.

5. The paraffinized preparation is placed on a layer of cotton to cool, care being taken to give it such a position as to avoid deformation.

[1] Michael v. Lenhossék. "Celloidinbehandlung des Gehirns zur Herstellung von Demonstrations-präparaten." Anat. Anz. ii., 3, p. 77. Feb., 1887.

[2] Bull. de l'Acad. roy. de Belg., 2 ser., xl., June, 1876.

[3] Anat. Anz., i., No. 12, p. 322, Nov., 1886.

SCIENTIFIC NEWS.

—Editors of the American Naturalist:—I have recently had my attention called to an error in my paper on Directive Coloration, and I wish to correct it as far as possible. Please have the following errata inserted where they will accomplish the most in this direction.

Errata.—On page 201, and 10th line of article on Directive Coloration, substitute Wallace for "Darwin."

On the 15th line of the same paper, erase the first five words.

Yours truly,

Tabor, Ia., Sept. 10th, 1888. J. E. Todd.

—A summary of the little that is known of John Abbot, the Natural History artist of Georgia, is given by S. H. Scudder in the *Canadian Entomologist* for August, 1888.

—Dr. Douglass H. Campbell has been appointed Associate Professor of Botany in Indiana University, Bloomington, Indiana.

—Dr. David S. Kellicott has been elected to the chair of Comparative Anatomy and Zoology in the Ohio State University, Columbus, Ohio.

—Dr. Julius Nelson, of Johns Hopkins University, goes to the experiment station established in connection with Rutger's College, at New Brunswick, N. J.

—Mr. George H. Parker has been appointed instructor in Zoology at Harvard University.

—The Western Society of Naturalists will hold its annual meeting October 24 and 25, 1888, at Champaign, Illinois, in the building of the Illinois State University. The presidential address will be delivered by Dr. S. A. Forbes. It is intended to give the meeting a distinctly educational tendency, and to this end essays on the methods of teaching the various natural-history sciences are expected from the members. These, together with the resulting discussions, it is hoped, will prove of considerable interest and value. There will also be papers upon microscopical, physiological and anatomical technique. The local hotels at Champaign and Urbana give rates of $1.50 and $1.00 per day. The headquarters of the Association will be at the Caldwell House, Urbana. The Secretary of the Society is Dr. J. S. Kingsley, Bloomington, Indiana.

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NOTES ON THE FAUNA OF THE ISLANDS OF FERNANDO DE NORONHA.

BY JOHN C. BRANNER.

FERNANDO DE NORONHA is a small group of islands in the south Atlantic, about 230 miles northeast of Cape St. Roque, and belonging to Brazil. It is only six miles long by about two wide. There is no important settlement upon it, and though it lies near the track of vessels plying between European ports and those lying south of the Cape, it is seldom visited by steamships and rarely by sailing vessels.

Very little is known of the natural history of this island. A very brief visit was made to it by Darwin in his famous voyage around the world, but the time he spent upon it—only a few hours —did not enable him to do much towards studying its natural history. In 1873 the Challenge Expedition landed here, but as the island is used for a penal settlement, the officer in charge of the colony would not give the party permission to make explorations. The few notes made by Mr. Darwin, and those of the Challenger party, furnish almost all the trustworthy information thus far published concerning it.

In 1876, when a member of the Imperial Geological Survey of Brazil, I visited Fernando de Noronha, and spent the months of July and August there, during which times the following notes were made upon its fauna:

The island is inhabited by a vast number of birds, most of

them sea-birds which flock and breed about the inaccessible crags and the small islands and rocks off the main island, and being but little disturbed by visitors, they are not timid, and may often be killed with clubs or caught with the hand.

One of the most interesting and beautiful birds on the island is the wig-tail, a white bird about the size of a pigeon, having two long flexible, streamer-like tail feathers.[1] These birds nest and roost mostly upon the lofty sides and about the summit of the great peak. At every hour of the day they may be seen hovering about this majestic rock like great white butterflies, or resting upon the little niches on its sides—white specks against the dark background. When seen at any considerable distance from their nests or roosting places they usually fly in pairs, side by side, each following the other's motions so exactly that one is at first inclined to think by some optical delusion there is but a single bird where two appear. They seldom fly in a straight line, but rise and fall and zigzag like butterflies.

Rats and mice exist here in such numbers as, at times, to constitute a very serious pest and drawback to agriculture. It is recorded that during the occupancy of northern Brazil by the Dutch, about 1630, Fernando de Noronha was abandoned "by reason of the vast numbers of rats which consumed all the fruits of the earth."[2] As one walks through the fields or along the paths he constantly hears their rustling on all sides, and sees them darting here and there through the grass. A certain number of the convicts are assigned to the work of rat-killing, and each one is required to kill a specified number of rats every days. The number is incredibly large—somewhere in the hundreds—but I made no note of it, and dare not speak from memory. Cats and dogs have been imported in the hope that they might aid in the extermination of the plague, but though they usually kill them eagerly during a few days, they soon become so accustomed to their presence that they cease to pay the least attention to either rats or mice.

I made no notes upon the occurrence of rats and mice upon Ilha Raza and Sao José, and do not recall having seen them on

[1] The inhabitants call these birds by the very appropriate name of *rabo de junco*—reed tail.

[2] John Neuhoff in Pinkerton's Voyages, vol. xiv., p. 701.

those islands. Upon Ilha Rapta there are no rats, but mice are even much more abundant than on the main island. If they constitute a plague upon the main island, what shall be said of them here? It is simply impossible to realize, without having seen and experienced them, how mice can exist in such numbers. I spent a night on this island, the guest of the three convicts occupying

the place at the time. My hammock was suspended in the solitary grass-thatched hut, and at night I tried to sleep there, but with very poor success. The mice were all over the floor of earth, in

[1] This island is usually and erroneously called Rat Island, an error due probably to the fact that the *p* in *Rapta* is silent, and is supposed to mean rat, which it does not. *Rapta* is from the verb *raptar*, to steal, and Ilha Rapta translated into English would be Robbers' Island, or literally, Stolen Island.

the walls of thatch, in the roof, among the pots and pans—everywhere. No sooner did I lie down in my hammock than they made their way down the cords and into my bed. During the early part of the night I amused myself by allowing them to reach the middle of the taut hammock cords, when, by striking the cords a sharp blow, the vibrations would shoot them off into space. This ceased at length to be amusement, and when, late in the night, I occasionally fell asleep, it was only to be awakened in a few moments by the mice nibbling at my face or hands or feet, or by their falling upon me from the roof.

The occurrence of rats upon the main island and of mice only upon Ilha Rapta may possibly be explained by the mice having been imported to the smaller from the larger island. The geology of this group of islands, however, suggests another plausible explanation. Fernando de Noronha and the small islands lying about the main one are of igneous rocks, with the exception of some limited exposures of comparatively recent calcareous sandstones formed by the consolidation of sand dunes. These calcareous sandstones form all of Ilha Raza and Ilha do Meio, the southwest third of Ilha Rapta, and overlie a portion of Sao José and the extreme northeast point of the main island. It occurs also at the southeast base of Atalaia Grande, and in the Bahia de Sudoest, where it forms Ilha de Chapeo and the shore of the bay in places.

In all these localities the sandstone is cut away on its southeastern side, and an abrupt or overhanging face is exposed to the ocean's surf, while its upper surface stands at an elevation of from thirty to fifty feet and more above the water. On the landward side of the exposures on Ilha Rapta, Sao José and the main island, these sandstone beds thin away to the west. These facts, and others which need not be mentioned here, go to show that the southeastern coast of these islands formerly extended much farther in that direction, and that the calcareous sands, of which these rocks are formed, were blown inland from the beach which once existed in that direction. The ocean, however, has gradually encroached upon the island, and especially from the east, until what was formerly one island has been separated into six, namely, Sao José, Sella Ginete, Ilhas do Meio, Rapta, Raza, and the main island.

The mice which are so abundant upon both islands now may

have been cut off from the main island and left upon Ilha Rapta when this separation took place. Whether they would survive upon the other islands, Ilha do Meio, Ilha Raza, etc., would depend entirely upon whether the conditions upon them for survival were favorable or otherwise, and their existence or non-existence at intermediate points would have but little bearing upon the question. It may be asked, in case this theory is correct, why we find no rats upon Ilha Rapta. This is possibly to be attributed to their having been entirely exterminated by the convicts.

Ilha Rapta is, in a sense, one of the institutions of the penal settlement. It has an area of less than a square mile, no wood, though it is said to have been wooded formerly, but little potable water, and, compared with the main island, it is very low. The soil is extremely fertile, and excellent sweet potatoes grow wild over a large part of it, while the waters about its shores swarm with edible fish and enormous sharks. When, at the time of my visit, and prior thereto, a prisoner upon the main island became particularly unmanageable, he was banished to Ilha Rapta, which was regarded as a sort of *insanctum insanctorum*, where he was left to his own devices for subsistence.

I learned from the commandant that formerly large numbers of convicts were banished to Ilha Rapta at the same time. Now it was generally understood when I was upon Fernando that rats were not uncommonly eaten by the convicts on the main island, and as those sent to Ilha Rapta were left to do as they saw fit, they were often reduced to great straits for food, and it does not seem improbable that they ate rats, if rats ever existed there. Then, too, when efforts were made to raise crops here, the rats, had they existed in such numbers as upon the main island, would simply have rendered such crops impossible. The area of the island is so small, and the places in which rats could hide so few, that their extermination would not be an impossible or even a very difficult matter.

I trust that the novelty of it will be sufficient apology for a short digression here to describe the method employed by the convicts on Ilha Rapta to catch fish. A hook attached to a line about 150 feet long, baited with a fresh sardine or the white skin of some other fish, is thrown out into the water and quickly drawn ashore.

The method is thus essentially trolling without a boat or spoon. One end of the line is tied to the fisherman's body, the line coiled and held in the left hand, while the baited hook, weighted with a bit of lead, is whirled rapidly above the head with the right hand, until the centrifugal force becomes strong enough to carry the line out to its full length when skilfully thrown. It is then allowed to escape, and the lead, carrying the line with it, shoots out over the water and drops. The line is then hauled in as rapidly as possible, and this rapid hauling in generally produces a whirling of the bait at which the fish strike. There is "many a slip," though, between hooking a fish and landing it; not that they are particularly game, but because the sharks are usually fishing at the same time and place. Not more than half the fishes I saw hooked here were landed entire; sometimes only half a one was hauled in, at others only a head, and sometimes the hook and part of the line were also missing.

Standing upon one of the overhanging rocks at the western end of the island I have looked down into the sea when it was comparatively smooth and seen hundreds of enormous sharks in the water, gliding over and about each other in their search for food.

Perhaps the most interesting vertebrate found on Fernando is a species of lizard—*Mabina punctatas.* The cultivation of almost all the tillable land on the island has had the tendency to drive these lizards into the rocky corners and uncultivated places, where they exist in such great numbers as to cause one to wonder how so many of them manage to live on so small an island. As they are but little disturbed, and have no natural enemies here, they are not very timid. Walking over the open, rocky places where there is no vegetation, one may see the lizards withdrawing down the sides of the rock fragments, apparently with much reluctance, at a distance of from three to six feet ahead of him. If he turn and look behind he will find them rapidly closing up the space yielded him for a passage. While seated upon the bare rocks I have often observed these little animals watching me, apparently with as much curiosity as I watched them, turning their heads from side to side as if in an effort to be wise. If I kept quiet for a few minutes they would creep up to me and finally upon me; if I moved, they

ran down the faces of the rocks, and turning, stuck their heads above the edges to watch me. I caught a great many of them[1] by keeping quiet until they came within easy reach and then snatched them. They bite freely, but their teeth are too short and weak to inflict a severe wound. Upon one occasion when climbing with my photographic apparatus up a steep bluff, where great care and attention had to be given to every step and motion, my movements were not sufficiently rapid and decided to keep the lizards off my person, and as neither of my hands was free, they became offensively familiar. Several of them crawled leisurely over me examining my clothing and my person, and one even got up the leg of my trousers, and for nearly an hour crept around and around my waist just below the band of my trousers.

I was told by the inhabitants that there was another kind of a lizard on the island which had two tails. I found, however, that the so-called forked-tailed lizard was the same as the above mentioned one. The tail of this species is long and slender, and is so easily broken that it was quite difficult to catch one without breaking off a portion of its tail. If the piece broken does not fall off entirely, the break may heal over sufficiently to hold it securely, while the growing out of the new tail gives the lizard a forked or double one. I have seen it stated, I believe in the Challenger reports, that this species has never been found elsewhere in the world than upon Fernando de Noronha, and that the species to which it is most nearly related occurs in Demerara.

I saw no snakes upon the island, and the old residents say there are none, save what is known in Brazil as the *cobra cega* (blind snake) or *cobra de duas cabeças* (double-headed snake). I found one specimen of this. It is a species of Amphisbæna.

Several insects are found, the most abundant of which is a species of wasp, which does considerable damage to grapes, and by building nests in the cajú trees renders itself very obnoxious. Spiders are also very abundant. A few beetles and butterflies were taken, but the material was turned over to Mr. Herbert H. Smith, and I am unable to say what they are. All kinds of domestic

[1] These specimens, like all the other material collected upon this island, was deposited in the Museu Nacional in Rio de Janeiro. As far as I know, none of it has ever been worked up.

animals have been introduced upon the island, but they do not enter into the biologic question to which I would call attention.

It does not seem improbable that the original flora and fauna of Fernando were introduced here at the same time and from the same source. I regret that I made no notes of value upon the flora of the island, but I may call attention to this peculiarity of it: its large trees produce light wood, that is, wood that will float in the water. The flora of the Brazilian mainland is noticeable for the predominance of very heavy timber, most of which, even when well seasoned, is of too high specific gravity to float in salt water. One of the large trees of Fernando is the *Ficus noronhae*, a species first described from this island. Another is the *burra*, a species of laurel yielding a poisonous juice. I believe I have seen the laurel in the highlands of the province of Minas Geraes, but I am not quite positive about the identity.

The question naturally arises: Where did the animals inhabiting this island come from originally, and how did they get to Fernando de Noronha?

The first answer which suggests itself is that they have been imported by man's agency since the place was discovered. Very fortunately we have valuable documentary evidence upon this subject. The following is a translation of the oldest document in existence referring to the island of Fernando de Noronha:—

" . . . . In view of the services which Fernam de Noronha, cavalier of our house, has rendered, and which we shall expect of him hereafter, and desiring to show him grace and mercy, we are pleased to bestow upon him henceforth for all the days of his life, and on his eldest legitimate son surviving at the time of his death, our island of Sam Joham which he has just lately discovered fifty leagues over the sea from our land of the holy cross."[1]

This is a portion of the patent issued by the King of Portugal, January 24th, 1504, at "Lixboa," and recorded in the royal archives of Portugal.[2] Now "Sam Joham," or in modern Portuguese,

[1] The original name given Brazil by Cabral was *Vera Cruz*. It was generally known, however, as the *Terra da Santa Cruz* until about the middle of the sixteenth century when the name Brazil was generally adopted.

[2] Real Archivo, Bk. 37, Chanc. D. Joao III., Fol. 152. (Dairio de Pero Lopes, p. 71–2.)

Sao Joao, was the original name of the island, and after this patent it appears to have been known by the name of its owner, Fernam, or Fernando, de Noronha.

From this document, and others relating to the fleet in which Fernando de Noronha sailed, it is believed that the island was discovered on the 24th of June (St. John's Day), 1503, and that it was called the island of "Sam Joham," or St. John, in accordance with the usage of the times, which was to name places after the saints upon whose days the discoveries were made.

Americus Vespucius claims to have visited this island on his fourth voyage,[1] six weeks after its discovery by Fernando de Noronha. I am aware that historians question whether this voyage was ever really made by Americus Vespucius, but judging from the description given by him it must be confessed that if that navigator did not himself see this island, he obtained his information concerning it from some one who did visit it, and for our purposes this serves the same end. If his informant was a member of Fernando de Noronha's party, it is only the more valuable in the present connection. The description given by Americus Vespucius is brief, but it is the earliest one published, and therefore the most important for the present discussion. According to this account he touched here August 10th, 1503, and he writes:—

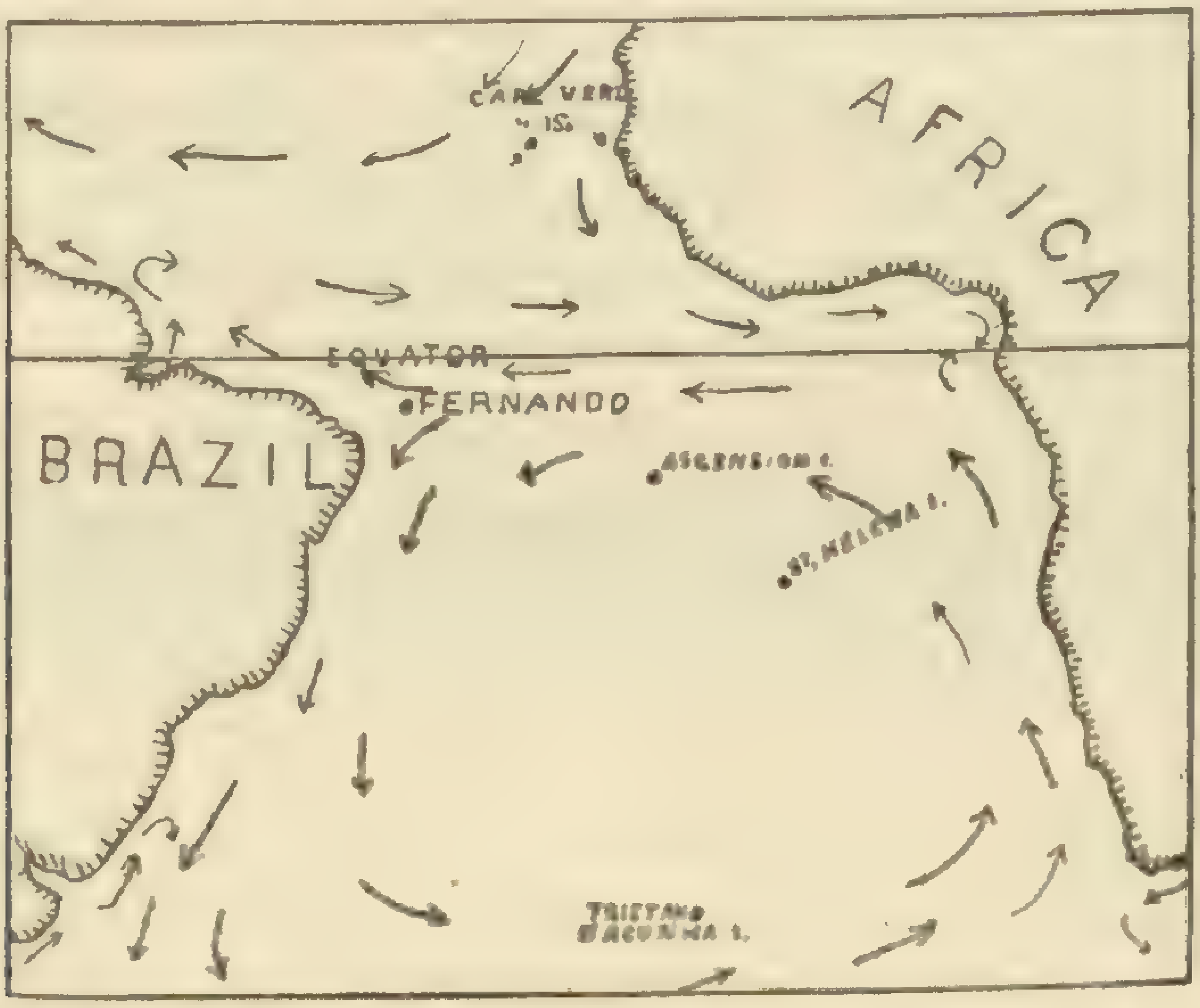
". . . . . Which island we found inhabited, and it contained plenty of trees, and so many birds, both marine and land, that they were without number, and they were so tame that they allowed themselves to be caught with the hand; and we caught so many that we loaded a boat with them; and we saw no other animals except very big rats and lizards with two tails, and some snakes."

As the introduction of birds, whether marine or land, upon an island 230 miles from a large continent, cannot be regarded as difficult or impossible, the presence of birds upon Fernando may be passed by as of no particular importance. The interest in this case centres upon the "big rats and lizards with two tails and some snakes" mentioned by Americus Vespucius. As the island was discovered but six weeks prior to the reported visit of this

[1] Stanislau Canovai's Viaggi d'Amerigo Vespucci, Ed. 1817, p. 110, *et seq.*

navigator, it is clearly impossible that these animals, if imported by the discoverer, could have multiplied in so short a time sufficiently to have attracted attention. Nothing is said of the mice, and it may therefore be that these are or are not aboriginal inhabitants of the island. But the rats are here, and the lizards with two tails, the only ones likely to attract the attention are here, and the Amphisbæna is here, an animal bearing such a resemblance to a snake that by most people it is called a snake, even to this day.

Where did these animals come from? Rats are world-wide in their distribution; the species of lizard found here has never been found elsewhere; Amphisbæna is abundant in Brazil, and in Africa, and one genus (Blanus) is found about the Mediterranean. If we suppose that they migrated from the Brazilian mainland, and that the *Euprepes* does occur, but has not yet been found there, a question as to method arises. Now as the ocean currents do not,



at any time of the year, set eastward, northeastward or southeastward from the eastern part of the South American continent in the direction of the island of Fernando de Noronha, the chance of such animals being carried from the Brazilian mainland are extremely small. The island receives the currents from the southwestern coast of Africa, as is shown in the accompanying cut; indeed the west flowing south equatorial current divides just about here, the current striking the island and flowing either to the northwest or to the southwest along the Brazilian mainland, according to the time of the year and the direction of the trade winds. The wind

charts usually represent the prevailing winds in this region as coming from the southeast. During the months of June, July, August, and September, they do come from that direction approximately, but during the remainder of the year they are usually from the northeast.[1] The ocean currents shift slightly with these prevailing winds, so that when the winds from the northeast have prevailed for some time, the main body of the south equatorial current seems to be carried further south. Such changes throw upon Fernando at one time the currents from southwest Africa, and at others probably some of the counter-currents from the North Atlantic or from the Gulf of Guinea.

Dr. Alfred R. Wallace, with whom the writer has spoken in regard to this question, suggests that these animals may have been introduced upon the floating trunks of trees from Africa. If we admit that such animals could endure so long an ocean voyage, the explanation satisfies the demands of the case as far as we are acquainted with them.

The long existence of navigation as a science prior to the discovery of America, suggests that rats might have been carried here upon a wrecked vessel. But even admitting that the Amphisbæna and the lizard might have come from some part of the Mediterranean, the chances of such animals finding their way upon board vessels are so extremely small that this hypothesis seems to have but little or no value.

It has been suggested also that the islands of Fernando may have been joined to the Brazilian mainland at one time, and that by the cutting away of the isthmus joining the two, the island was thus left with the fauna found by its discoverers. The form of the ocean's bottom between the mainland and the island puts this hypothesis out of question. It was formerly supposed that Fernando had once been the northeastern point of Brazil, but the deep-sea soundings by the Challenger expedition show that this is not true, and that Fernando is separated from the mainland by a trough more than 12,000 feet deep. In the light of these facts the question remains: where did these animals come from, and how did they get here?

[1] During my stay upon this island, in the months of July and August, the wind varied but little from due east, being at times from the E. N. E., and at others from the E. S. E.

VALUES IN CLASSIFICATION OF THE STAGES OF GROWTH AND DECLINE, WITH PROPOSITIONS FOR A NEW NOMENCLATURE.[1]

BY ALPHEUS HYATT.

IN accord with views brought to the notice of the society in 1884, under the title of the "Larval Theory of the Origin of Tissue,"[2] an abstract of which was subsequently printed in *Amer. Journ. Sci.* May 31, 1886, we divide the animal kingdom into three comprehensive divisions: (1) PROTOZOA, unicellular animals, which propagate by means of asexual (autotemnic) fission and by spores, and build up colonies, but always remain typically unicellular. (2) MESOZOA, multicellular colonies, but composed of only one layer of cells, so closely connected, that they may be called a primitive tissue, and having more or less spherical forms.[3] They propagate by means of ova, spermatozoa, and by autotemnic fission,[4] and have an aula or common cavity, but no specialized digestive cavity or archenteron. (3) METAZOA, complexes of multicellular colonies, in which growth by sexual union, and resulting fission of the ovum, forms three primitive tissue layers and builds up a body in which an archenteron is always developed. They propagate always by means of ova and spermatozoa, autotemnic fission occurring only, if at all, during the earliest stages of the ovum. Holoblastic ova may be regarded as the more primitive or generalized forms to which all

[1] Abstract of a paper read at the meeting of the Bost. Soc. Nat. Hist., Nov. 16, 1887. Vol. xxiii.

[2] Proc. Bost. Soc. Nat. Hist., vol. xxiii., 1884, p. 45.

[3] See Butschli's remark that the closely appressed hexagonal cells of the envelope are connected with each other by threads of propaplasm. Bronn. Thierreichs, vol. i. Protoz., p. 775.

[4] The best summary of all observations is in the work just quoted, where Butschli calls the sexual cells ova and spermatophora, but alludes to the cells developing by autotemnic fission as Parthenogonidia. They are by his own descriptions and those of others, ova, which differ from sexualized ova only in their ability to develop through autotemnic fission.

other forms of ova having more or less specialized and concentrated modes of development may be referred as derivatives. The stages of holoblastic ova may be in a general way classified as follows, to accord with that given above for the Animal Kingdom :—

(1) The ovum or Monoplast (Lankester); (2) the first stage of segmentation, which normally results in the production of two cells in the same place originated by vertical fission, the Monoplacula; (3) the second stage of segmentation in which two layers arise, the Diploplacula. The first two stages alone seem to have parallel or representative adult forms among Protozoa. The differentiation into esoteric, primitive ectoblast, and enteric, primitive endoblast cells takes place in the Diploplacula, and the morphological equivalent of this stage of the ovum, having an upper layer of differentiated feeding cells, has not yet been found among the adults of the Protozoa; though, if this is correct, such a discovery may be reasonably anticipated. We have proposed to classify these stages under the name of Protembryo.

(4) The Blastula is in aspect and general characteristics the morphological equivalent of the adults of the genera Volvox and Eudorina, the types of the Mesozoa or Blastrea. The latter are animals in which growth remained permanently arrested at the single-layered, spherical stage in the evolution of tissue-building forms. We have proposed to classify these stages under the name of Mesembryo.

(5) The Gastrula can be compared, as has been done by Hæckel, with the lower Porifera (Ascones), but these have three layers like the lowest Hydrozoa, in which a three-layered gastrula-like stage has been permanently preserved.[1] The proper name for these stages would therefore be Metembryo, in allusion to the fact that the ovum at this stage is probably essentially a Metazoon.

(6) The first and simpler Planula stages, though often character-

[1] The true two-layered Gastrea type of Hæckel has, therefore, not been discovered. Doubtless, some such animals bringing the gap in the line of graded modifications between three-layered Ascones and single-layered Volvox will yet make their appearance, but we cannot consider any of the animals heretofore described as filling this gap to be entitled to such a position. They have all proved to be either three-layered, or else to belong to the true Mesozoa or Protozoa. See also for remarks on the prevalence of the three layers even in the gastrula, Metschnikoff, "Ueber gastrula einiger Metazoen" Zeitz. Wissen. Zool., V. 27, 1882, p. 305.

istic of the larger divisions of the Animal Kingdom, would not, if arrested at this period, be recognized as belonging to the same groups as their existing adults. They do not possess, as a rule, the essential diagnostic characters of the larger divisions to which they belong, and we propose to call them Neoembryos. Examples: the Cinctoplanula is not a sponge, the Planula of the Coelenterata is not a Cœlenterate, nor the Pluteus an Echinoderm, nor the Trochosphere a Mollusc, nor the Pilidium a Nemertean worm, nor the earliest planula-like ciliated stages of Amphioxus a Vertebrate. Neoembryos are, as pointed out by Semper,[1] Lankester[2] and Balfour,[3] so similar, that they may be considered as indicating a common ancestor for the entire Animal Kingdom.

(7) The latest of the more specialized planula-like stages are either directly transformed into, or else give rise to other forms in which the characters of the larger subdivisions or types of the Animal Kingdom begin to appear, at least so far as essential characters are concerned. Examples: the Ascula and Ampullinula are true sponges, the Actinula is a Hydrozoon, the Gulinula is an Actinozoon, the Veliger is a Mollusc, the internal worm-like form arising in Pilidium is a true Nemertean, the formation of the notochord in Amphioxus makes the planula-like embryo into a vertebrate animal. They have the essential characters of the larger subdivisions, though it is equally true, that embryos in this stage of development are very remote, in some cases, from the adults of any normal forms. We do not, therefore, misinterpret these relations by naming the embryo in these last stages the Typembryo. This term can be applied to the Nauplius of Crustacea, and the Echinula[4] of Echinodermata, as well as to those above noted.

[1] Semper, Stammsver, Wirbel. und Wirbello., Arbeit. Zoolog. Zootom Inst., V. ii., p. 59, and V. iii., p. 384. This distinguished author states in Volume iii., that his "Trochosphaera" is identical with the "ungegliderte Urnierenthier" which in his first table in Volume ii., appeared as the common ancestor of the higher animals, *i.e.*, of all animals except Echinodermata and Cœlenterata.

[2] Lankester traced the Mollusca, Annelida, Rotifera and Echinodermata to what he calls the Archítroch, a common form taken from somewhat earlier stages of the Planula than those selected by Semper for his Trochosphaera. Embryol. and Classif. Journ. Micros. Sci., vol. xvii., 1877, p. 423.

[3] Balfour, Comp. Embryol., vol. ii., p. 311.

[4] Alexander Agassiz, Address, Am. Ass. Adv. Sci., V. 29, 1880, p. 410, shows that there is a stage of the embryo common to all orders of living

Typembryos serve to connect the earlier stages of the Neoembryos with the true larval stages which succeeded the former. Balfour and other embryologists have used the term "larva" for free neoembryos and typembryos. This term should be confined to the designation of stages of growth which are immediately continuous with later stages and parallel, or referable in their origin to the adults of allied, existing, or fossil forms, which are not so remote as those from which the embryonic stages were derived.

The application of such principles to the study of the younger stages of fossil Cephalopoda is productive of what seem to be satisfactory results. The protoconch of Owen is, according to this nomenclature, the shell of the univalve veliger of the Cephalous Mollusca, and a true typembryo which, though eminently characteristic of that group, has no exact morphological equivalent among adults of normal forms whether recent or fossil.

The protoconch in fossil Nautiloidea is represented by a withered-looking lump sticking to the apex of the conch in a very few exceptionally perfect specimens. The very general absence of this lump and the presence of a scar left by its removal on the apex of the conch, and the wrinkled, shrunken aspect of the lump when preserved, indicate the protoconch to have had a horny texture in this order. This typembryo shell must have existed among Nautiloids with an almost unchanged aspect from the earliest Cambrian (Lower Silurian) horizon until the present day, and its adult equivalent probably existed before its appearance in Cephalopoda or in the equally ancient and allied group of the Pteropoda, which also had similar protoconchs.

The true larval, or as they are here named, Silphologic[1] stages, began with the formation of what Owen has appropriately called the apex of the conch or true shell. Among Nautiloids this was a short living chamber occupied by the body of the animal, but having no

Echinodermata. This stage, however, was not named in the address above quoted, which was intended as preliminary to an illustrated essay on the same subject, and Mr. Agassiz has supplied that omission in the following note, which I quote from a letter to me. "I intended sometime when revising my 'Address on Palæontological and Embryological, Development,' to call the earliest common stage of echinoderm embryos 'Echinula' for convenience in making comparisons.—A. Agassiz.'

[1] Σίλφη, a grub.

siphon or septum. It was completed by the deposition of the apical plate, which sealed up the aperture of the protoconch thus closing the opening and cutting off communication between the two interiors.

This stage can therefore be named the asiphonula or siphonless larva. The apex of this conch was rounded, being built out in concentric circles from the contracted aperture of the protoconch, probably before this was plugged up by the deposition of the apical plate. The asiphonula was not a Cephalopod, since it had no central siphon, nor even a septum. It may have resembled more or less closely the adults of some of the ancient Pteropoda. Von Jhering has thought, that the characteristics of the early stages of Ammonoids justified a comparison between them and forms of Pteropoda having similar protoconchs. This was our own position also, but we now see, that the asiphonula was not necessarily a wholly pteropod-like animal. It may have retained many of the veliger's characteristics, and may have more or less resembled a generalized type to which a Scaphopod is the nearest living approximation. Prof. W. K. Brooks' opinion, that the Scaphopods are such a generalized type and that the veliger has characters which can be compared with those of the adult of Dentalium ought at any rate to be considered here.

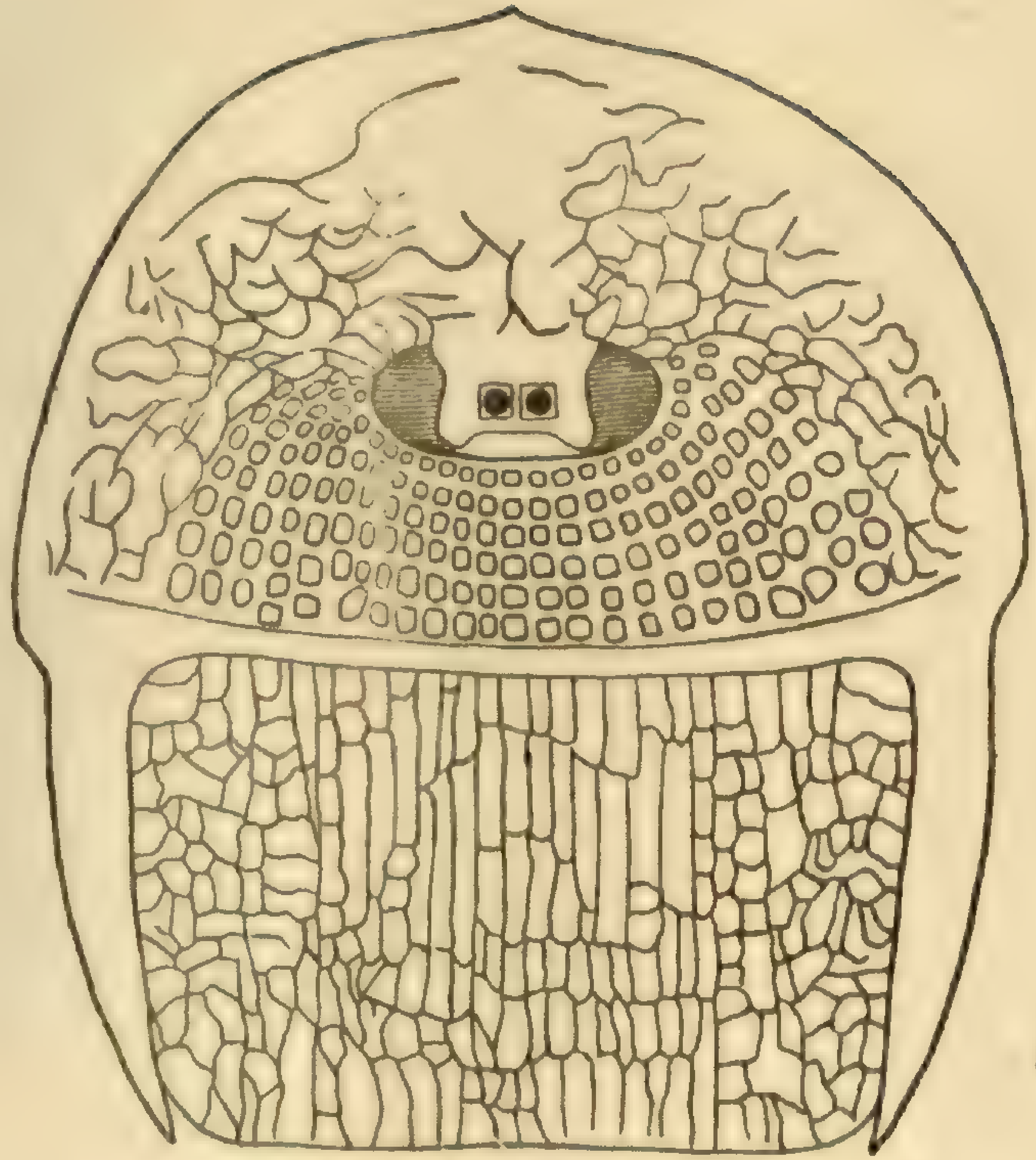
It is not at all improbable, that the Pteropoda may never have served as radicals for the Nautiloids or Ammonoids, but the latter may have sprung directly from the ancient Scaphopoda.

The cicatrix naturally suggests comparison with the posterior opening in the shell of Dentalium, but if our view is the true one, and it represents the aperture of a protoconch, no such comparison can be made. The development of the conch in Dentalium is, according to Lacaze Duthier's researches, directly continuous with that of the protoconch, and the posterior opening is the result of the peculiar mode of growth of a primitive plate of shell which is never closed up. The shell, in other words, is a *periconch* growing around the body in the veliger and finally coalescing to form a tube open at both ends.

The second larval stage in Nautiloidea was composed of a living chamber closed apically and completed by a single septum, which had a cæcal prolongation reaching across the first air chamber and

[1] Proc. Bost. Soc. Nat. Hist., Aff. Moll. and Molluscoid., V. 18, 1876.

PLATE XV.



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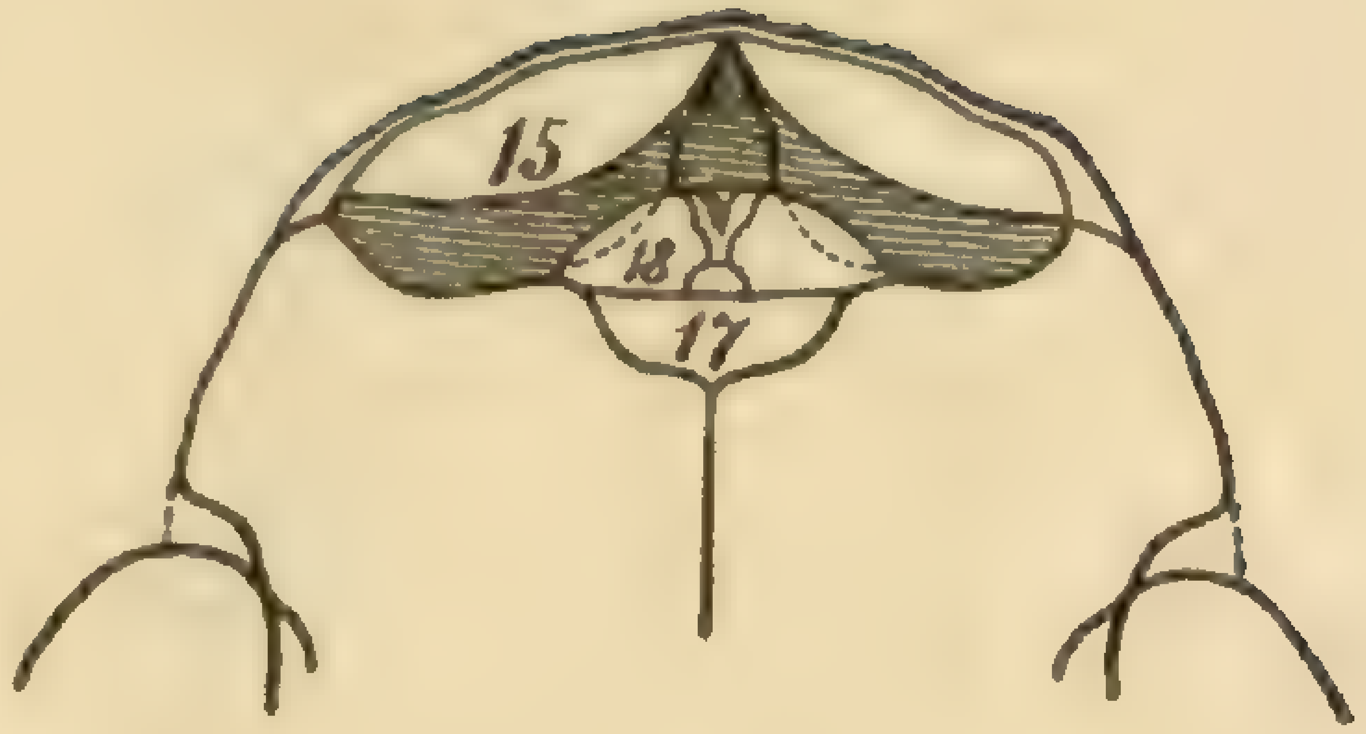

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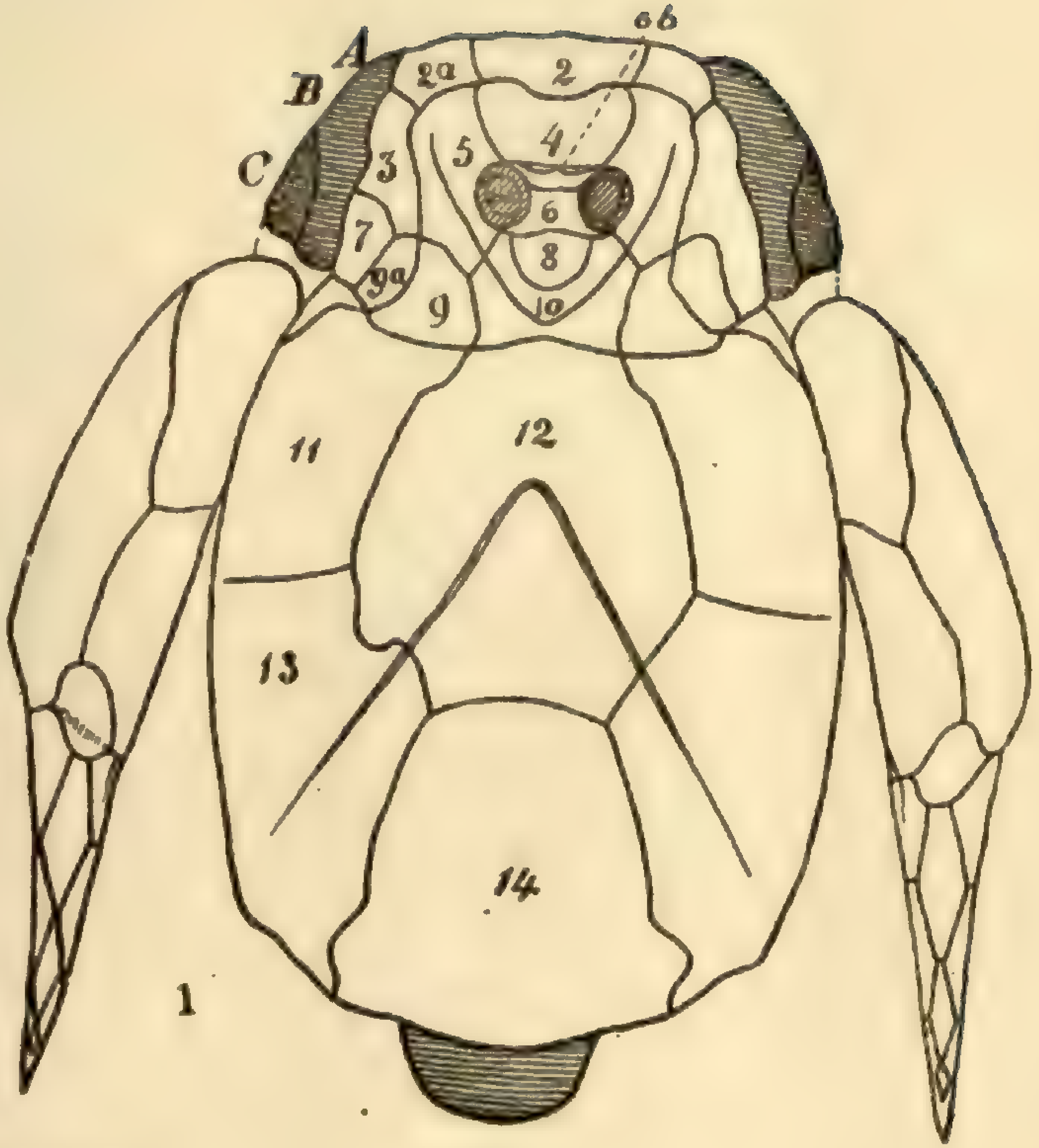


1

Fig. 1. Shell of *Bothriolepis canadensis* Whiteaves, from above. (From Whiteaves.)
Fig. 2. Anterior part of same from above. (From Whiteaves.)
Fig. 3. Skull of *Mycterops ordinatus* Cope, from below, $\frac{2}{3}$ natural size.

resting upon the inner side of the scar. It is proposed to call this stage the Cæcosiphonula, since it is undoubtedly the primitive stage of that organ. The cæcosiphonula may indicate the former existence of an ancestral form having a central axis composed of similar closed funnels or cæcal pouches.[1]

The third Silphologic stage in Nautiloids was completed by a septum (the second in the apical part of the shell) having an open funnel extending apically and joined to a loose textured siphonal wall which reached down into and lined the cæcum, thus forming a secondary closed tube. In accordance with the structure this has been named the Macrosiphonula.

The protoconch was present in Ammonoids and also in Belemnoids, but in both of these orders it was calcareous. The tendency to form a calcareous shell, which first appeared in the apex of the conch of the asiphonula in Nautiloids, became by concentration of development inherited earlier in the Ammonoids and Belemnoids in the veliger stage, thus transforming what would otherwise have been a horny shell into a calcareous one. The protoconch was, however, not otherwise changed in external aspect and retained the usual egg-like shape of the univalve veligers of the Cephalophora. As in the protoconchs of other similar veligers of Gasteropoda, etc., and as a result of calcification, the protoconch became fused with the apex of the conch more intimately than in Nautiloids. In other words the asiphonula, after transmitting a portion of its characteristics to the typembryos of the Ammonoids and Belemnoids, disappeared, having been replaced by the Cæcosiphonula. The septum of the cæcosiphonula was consequently also inherited earlier, and became a functional substitute of the apical plate serving to close the aperture of the protoconch, and its cæcum extended into the upper part of the otherwise empty protoconch, in place of occupying the first air chamber as in Nautiloids. This is a remarkable example of the law of concentration, but by no means exceptional. The fourth larval stage of the Nautiloids was completed by the building of the third septum. This septum had a long funnel and attached porous wall, but the wall formed a true siphonal tube opening apically into the next section, the macrosiphon. This

[1] See also similar remarks by Whitfield, Bull. Amer. Mus. New York, No. 1, and Embryol. Ceph. by the author, Bull. Mus. Comp. Zool., V. 3, No. 5, p. 100.

was the beginning of the small siphon and can be appropriately termed the Microsiphonula. The microsiphonula was the typical stage of nearly all the known genera of Nautiloids, beginning with the Orthoceratites of the Cambrian and found at the present time in Nautilus, and also in all Ammonoids and Belemnoids without exception.

Fortunately the genesis of both macrosiphonula and microsiphonula can be traced in the adult forms and silphologic stages of well-known fossils. The Crytocerina had a siphon which was macrosiphonulate probably even in the adult stage, since it increases in diameter throughout life. Piloceras had a huge siphon hardly at all contracted in the adults of some species, but considerably lessened in diameter during the same stage in others. Endoceras had also a large siphon always more or less contracted in the silphologic or later stages. The uncontracted macrosiphonula occupied in this genus a number of air chambers varying according to the species, from a few to six or more. This was evidently due to the earlier inheritance or concentration of the tendency to decrease the diameter of the siphon first manifested in the adults of Piloceras. Sannionites was a genus in which the siphon was smaller than in Endoceras, and probably, though this is not yet ascertained, inherited the tendency to microsiphonulation at the first septum at an earlier age than in Endoceras. None of these forms, however, attained a true microsiphon, since even Sannionites had the siphon filled by endocones and in the centre an endosiphon. These organs entirely disappeared in true microsiphonulate forms and, in fact, could have existed only within a large macrosiphon.

Nevertheless this tendency to decrease the size of the siphon resulted in the formation of a definite constriction. This constriction was inherited at earlier and earlier stages after its origin in the siphon of Piloceras, until it became constant perhaps in Sannionites and certainly in the Orthoceratidæ. The constriction marked the line between the larger and smaller siphon in the macrosiphonulate forms, and, in becoming constant through concentration, it became invariably fixed behind the first septum between the cæcosiphonula and the smaller siphon. This smaller siphon, though still a macrosiphon in structure, as explained above, even in

Sannionites, was undoubtedly transitional to the true microsiphons of the Orthoceratidæ.

The cæcosiphonula was in all Orthoceratites, which are otherwise similar to Endoceras, confined by concentration of development to the first air chamber, and a true microsiphonula appeared at an early stage as an open narrow tube. This was similar to the siphon of the vast majority of all succeeding forms of both Nautiloids and Ammonoids. According to the classification here advocated, the stages preceding the microsiphonula, viz.: the asiphonula, cæcosiphonula and macrosiphonula, became silphologic stages in all the groups of Cephalopoda descending from the radical Endoceratidæ. Microsiphonulation became silphologic in the Orthoceratidæ, and the smooth shell which they evolved was subsequently inherited among Nautiloids, Ammonoids and Belemnoids during the younger stages in all the species of these orders. Other forms, with depressed and involved whorls, were introduced in the main stock of radicals among Goniatitinæ, and were modifications of the smooth cylinder of the simpler Orthoceratidæ with its microsiphon. These in turn became the proximal radicals of derivative groups. Thus the Anarcestes [1] among Goniatitinæ became the radicals of the Ammonoidea, and the smooth silphologic stages of all Ammonoids after the expiration of the Devonian were like the adults of these lowest forms of Goniatitinæ. This later acquired silphologic stage has therefore been styled the Goniatitinula.

It has also been found, that in tracing the descent of forms within smaller groups, sub-orders, families, and genera, it is practicable, as in the case of the family of Endoceratidæ, to prove that characteristics usually appear first in adult stages and are then inherited at earlier and earlier stages in successive species of the same stock, whether they occur on the same horizon, or in different horizons. The adolescent or Nealogic [2] stages are of as great importance for tracing the genealogy of small groups as are the silphologic characters in larger groups. Thus one can speak in definite terms of the relations of the nealogic stages, and their meaning and importance in tracing the genealogy of families and genera,

[1] Gen. Ceph. Proc. Bost. Soc. Nat. Hist., V. 22, 1880, p. 305.

[2] *Νεαλής*, youthfulness.

without danger of confusing them with the characters of any of the silphologic stages.

After the silphologic and nealogic stages have been disposed of there still remains the adult period, which is equally important in genealogical investigations, since it enables the observer to study the origin of many characters, which afterwards become silphologic and nealogic in descendent forms.

It is not uncommonly assumed, that adaptive characters appearing in embryos and larvæ are apt to be transient and have but little effect on the subsequent history of the early stage in the same group; also, that such characters have appeared just as readily in the larvæ as in adults. Up to the present time this has not been found to be true among fossil Cephalopoda, and there exist, so far as known to the author, but few characteristics probably originating in the early stages. The constant recurrence of hereditary characteristics in silphologic and nealogic stages which originated in adults, like those given above for the Endoceratidæ, makes the probability of the assumption, that the asiphonula and veliger represent the adult stages of lost types, so highly probable, that the burden of proof must rest upon the opponents of this argument. Each case of the origin of characters in embryo and larvæ should in other words be regarded with distrust until proven.

The appearance of the incomplete modes of segmentation in existing Sepioidea may possibly be a case of origination in embryo. There are no adult forms known to the author, which store up food in their tissues in such a manner that they can be used to explain the origin of the specialized food yolk. Nevertheless special inquiry might have very unexpected results. The case above given of the calcareous nature of the protoconch, and all the other characters of the stage in the Ammonoids and Belemnoids, seemed to have originated in embryo until it was found that a distinct silphologic stage, the asiphonula, existed in Nautiloids, and that this indicated the former existence of an asiphonulate ancestor having a calcareous shell.

Some of the characters of the goniatitinula, such as the deep ventral saddle of the first septum in the angustisellate young, as described by Branco, doubtless originated in the younger stages. These are, however, correlative with the anarcestian form of this

stage and with a general tendency to closer involution, which acted the same way in every series of forms, whether we select series of adults or of embryos for comparison.

The use of a distinct term for the adult period becomes necessary not only on this account, and to separate its relations from those of preceding periods, but also because of the constant recurrence and importance of representative forms. The term Ephebology[1] has accordingly been adopted for the designation of the relations of the adult stages, and under this term can be classified also the representation of similar forms in different groups or morphological equivalents. These are often so exact that it becomes very difficult to separate them. They have been and will continue to be the most difficult and misleading obstacles to the student of genealogy and classification.

In former essays we have described and defined the senile transformations and their correlations with the degraded forms of the same groups. The nature of these relations is, as has been explained, quite distinct from those of the progressive and adult stages, but the correlations are nevertheless equally important for the classification and tracing of genealogies during the declining period of a group, and in the case of degraded and aberrant forms. We have, therefore, for some years past designated these relations by the term Geratology.[2]

This nomenclature is similar to that adopted by Hæckel, but is, when properly considered, also supplementary and based upon morphological rather than physiological grounds. This eminent author regarded the ontogeny of an individual to be divisible into three periods: first, the stages of Anaplasis or those of progressive evolution; second, the stages of fulfilled growth and development, Metaplasis; third, those of decline, Cataplasis. He also appreciated and gave full weight to the general physiological correlations which are traceable between the history of a group and the life of an individual, and, in accordance with these ideas, designated the progressive periods of expansion in the phylogenetic history of a group as the Epacme, the period of greatest expansion in number and variety of species and forms as the Acme, and the period of decline in numbers of species, etc., as the Paracme.

[1] *Ἔφηβος*, the age of puberty.
[2] *Γέρας*, old age.

Hæckel used also the term Anaplastology for the physiological relations of the stages of progressive growth and those of the Epacme of groups, Metaplastology for those of the adult and the Acme of groups, and Cataplastology for those of the senile stages and the Paracme of group. These terms seem to cover the same ground, as those we have employed, but they were in reality chosen for the purpose of classifying physiological relations. Thus the anaplastic relations of the Embryologic, Silphologic and Nealogic stages to the phenomena occurring in the Epacme of groups, and the metaplastic relations of the Ephebolic stages to the phenomena occurring at the Acme of groups, and the cataplastic relations of the Geratologic stages to the phenomena occurring during the Paracme of groups, are the functional relations of one class of morphological modifications to those of another class and do not properly include the morphological phenomena themselves or their morphological correlations.

The necessity for a double set of terms may possibly not be at first admitted by many zoologists on account of their too exclusive devotion to the morphological side of their studies, but a very slight experience in trying to express the serial correlations of morphological and physiological phenomena will very soon show them, the convenience of such a nomenclature. Geologists have already arrived at this conclusion with regard to the classification of strata in the earth's crust and have begun to use two parallel series of terms, one giving the nomenclature of the relations in time, Era, Period, Age, etc., and the other the faunal relations under the headings of Group, System, Stage, and so on.[1] The time has come for recognizing a similar parallelism between structural or statical phenomena of organisms and their dynamical or physiological relations in time, and it is necessary to separate these clearly by different series of terms in order to see not only how they are separable, but also their correlations.

We have been more or less constantly observing and publishing on the Geratologic stages among fossil Cephalopoda for more than twenty years and have repeatedly described the more or less exact comparisons, which can be made between the different stages of decline in the individual and the degraded forms occurring in the same group.

[1] G. K. Gilbert, Address, Am. Ass. Adv. Sci., 1887.

There were two stages in the old age period among Ammonoids: the first of these can be designated as the Clinologic[1] stage. This immediately succeeded the ephebolic period and during its continuance the nealogic and ephebolic characteristics underwent retrogression. Ornaments, spines, and sutures degenerated and lost their angularity, the ribs of pilæ, and often the keel and channels, when the latter were present, became less prominent, and before this stage closed the whorl itself sometimes decreased, showing that degeneration in the growth force of the animal had taken place. Similar phenomena can be easily observed in other departments of the animal kingdom, notably in man, whose habits tend to preserve life until he has attained extreme age. During this period there is a steady loss of the differential characters acquired during the stages of progressive growth and there is a tendency to resume the proportions and aspect of the earlier nealogic stages. In man, baldness of the head, loss of teeth and resorption of the alveoli, loss of the calves, rotund stomach, and the return of early mental peculiarities, are phenomena of similar import.

The last changes in the ontology of the animal may be termed the Nostologic stage,[2] and during this stage these tendencies reached their highest expression. Among Ammonoids the ornaments were all lost by resorption, the whorl became almost as round and smooth as it was in the silphologic stage, and in extreme cases it was separated from the next whorl, leaving a perceptible gap. This almost complete reversion to the aspect of the silphologic stage can of course only occur in animals which attain an extreme age.

The correlations of Clinology are exact, and indicate the changes which may be expected to occur in the same group whenever degraded or aberrant species can be traced in a more or less continuous series of graded modifications starting with any given normal form. Many such series have been traced, and these are recognized now by all palæontologists as genetically connected. They began with normal, close coiled, ornamented, shells, the descendants were smaller, showing a tendency to be less involved by growth, to lose their ornaments, and simplify the outlines of the sutures, though

[1] *Κλίνω*, to incline downwards.

[2] *Νόστος*, a return.

they had coiled young stages similar to those of the normal forms from which they must have originated.

The correlations of Nostology can only be artificially separated from those of Clinology, but there existed one class of forms which can be compared only with the nostologic stage. These are the degenerate straight Baculites-like shells, which belong to several distinct genetic series and should often be widely separated on that account. Their resemblances are undoubtedly close, but they are due to degeneration and, therefore, simply homoplastic. Naturalists sooner or later will begin to recognize that degeneration may produce close representation in forms having distinct origins. The Baculities is a smooth, straight, cylindrical though slightly compressed shell, which has so completely reverted that it resembles an Orthoceras, though it is an unquestionable Ammonoid of the Jura and Cretaceous.

THE POISON-APPARATUS OF THE MOSQUITO.

BY PROFESSOR G. MACLOSKIE.

THE oral armature or proboscis of the mosquito (*Culex*) is described and figured in Dimmock's *Mouth-parts of Some Diptera*, and consists of a labrum, two mandibles, two maxillæ, surrounding a hypopharynx, and all these enclosed in a loose scale-covered sheath, which is the labium. They are nearly three millimetres long, about four times as long as the head; and all except the sheath are smooth, chitinous stylets. The maxillæ bear maxillary palps, scaly, four-jointed, about as long as the head in *Culex*, and three times as long in the allied genus *Anopheles*. I have only to add to Dimmock's description that besides the somewhat coarse serration of the maxillæ (about fifteen teeth near the top of each), Minot S. Morgan, of Princeton, has shown very fine serrations on the upper part of the mandibles (about forty-two minute teeth on each).

The hypopharynx is in the axis of all these mouth parts, being inserted by a basal enlargement close behind the oral aperture, and

flattened so as to form the floor of a sucking tube whose sides and roof are formed by the grooved labrum (or labrum-epipharynx according to Dimmock). This sucking tube extends back in the head, piercing between the upper and lower brain, and enlarged in the posterior part of the head into a large pumping organ, which forces the imbibed fluid backwards into the œsophagus and stomach.

In the last century Reaumur thought he could detect a drop of saliva ejected by the proboscis when stinging; he supposed that this is poisonous, and that its special function is to prevent the coagulation, and thus to promote the flow of blood by suction when the insect operates on our skin. We do not believe that he possessed any instrument that could show the poison; but his inference as to the presence of poison and its function is almost certainly correct. It seems to us, however, that the chief food of this insect is not animal blood, but the proteids of plants; and probably the fluid ejected may prevent the coagulation of all proteids, and so promote the process of suction.

It has been very often suspected that the poison-duct is contained in the hypopharynx, which has a thickened axis, like a rod, supposed by some observers to be tubular. Dimmock made out the tubular character of the corresponding part of some of the larger non-poisonous Diptera, but he was not able to demonstrate its tubular character in Culex. In addition to his observations that go to prove the existence of poison in its bite, I may add my own observation, that even when failing to draw blood its bite will sometimes swell the part, the subcutaneous tissue being irritated by poisonous matter. He concludes from the careful examination of all the parts that no other channel can conduct this poison; and adds, "This, together with the position occupied by the salivary duct in other Diptera, leads me to believe, without as yet being able to give anatomical proof of it, that the hypopharynx of Culex contains a duct that pours out its poisonous saliva"; and he further states that he was unable to determine the actual presence of the glands.

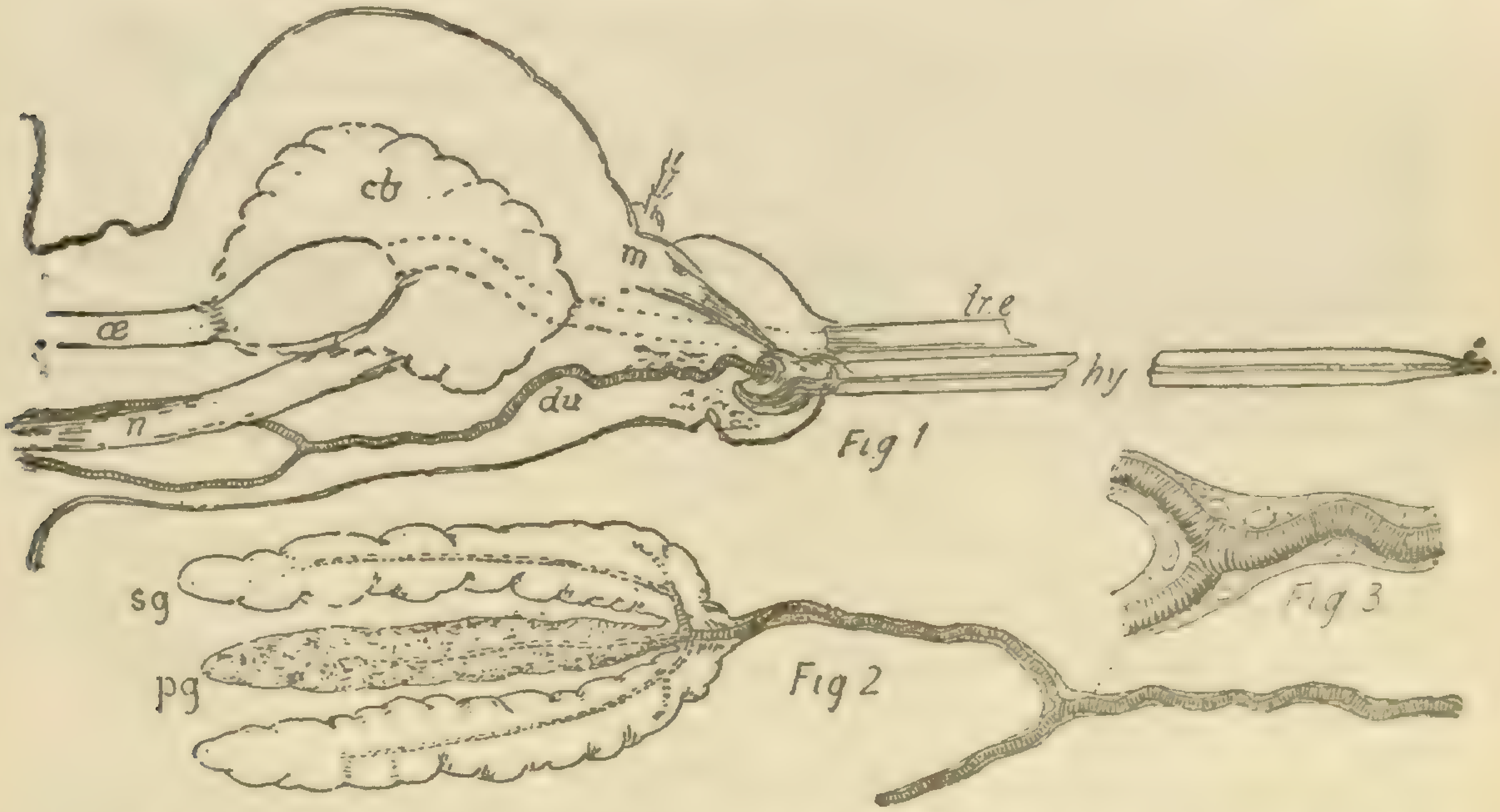
A year ago I succeeded in making out the duct and also the glands, and published a preliminary note; I was unable, however, at that time, to correct errors or to complete the work. This

past summer, however, gave me an opportunity of revising the subject, so that I have acquired some facility in finding and dissecting the parts. I find that it is even easy to see the venomo-salivary duct from the outside, shining through the skin at the base of the head and neck in the undissected specimen. Also, thanks to the supervision of Professor Libbey and the manipulation of Dumas Watkins, of Princeton Histological Laboratory, I have been supplied with a set of excellent sections, which show the relations of the parts. One of these sections is here engraved in part (Fig. 1), exhibiting the insertion of the duct into the base of the hypopharynx, and its course below the nerve. I have also teased out and stained some of the glands, which have enabled me to show their structure and relations, as in Fig. 2.

The secret was first discovered by an observation of fine droplets of a yellow, oily-looking fluid escaping from the apex of the hypopharynx (Fig. 1). I was then able to trace the course of this fluid down through the axis of the hypopharynx, its being divided in parts into droplets, and so indicating the tubular structure of this organ. On examining the base of the hypopharynx I found it to be enlarged like the mouth of a trumpet, and provided with a sac-like reservoir, into which the end of a fine duct was inserted. Working backwards I saw the duct to be of the usual character of salivary ducts in the Diptera, but much finer than usual, being less than eight microms in diameter, against thirty-seven microms in the house-fly.[1] It is not readily identified by a low microscopic power, and this may explain why it has not been previously detected. It has the usual chitinous lining, surrounded by the nucleated hypodermis which secretes it, transversely striated as in tracheæ (Fig. 3); but it is distinguished from the tracheæ by the comparative smallness and constancy of its diameter, and by the absence of ramifications. It runs back in the lower part of the head, beneath the nervous commissure (*n* in Fig. 1), for two-fifths of a millimetre. In the throat it bifurcates, its two branches being each as long as the undivided segment, and running on the right and left of the nerve-cord into the prothorax, where they terminate in glands of characteristic structure.

[1] A microm is one-thousandth part of a millimetre, or one-twenty-five-thousandths of an inch.

The glands are in two sets, one on each side in the antero-inferior region of the prothorax. Each set consists of three glands, two of which are of the usual aspect of salivary glands, resembling in structure, but not proportionately as long as, the single salivary gland on each side in the prothorax of the house-fly. The third gland, that occupying the centre of each set, is different, being evenly granular, and staining more deeply than the others; its function being without doubt the secretion of the poison. Each gland is about one-third of a millimetre long, and one twenty-fifth of a millimetre broad; the three are arranged like the leaves of a trefoil; and each is traversed throughout by a fine ductule, the three ductules uniting at the base to form a common duct, which is like a pedicel of the trefoil and is one of the branches of the bifurcated venomo-salivary duct. The ductules of the lateral glands of each set receive a minute branchlet near the base. Thus there are six glands, three on each side, two of them poisonous and four



Explanation of Figures.—Fig. 1. Median section of head, showing (*du*) the venomo-salivary duct, with its insertion in (*hy*) the hypopharynx: *cb*, cerebrum; below this is the cerebellum, and the pumping enlargement of (*œ*) the œsophagus: (*lr. e.*), base of labrum-epipharynx; (*m*) muscle; (*n*) nerve-commissure. Other parts removed.

Fig. 2. The venomo-salivary duct, showing its bifurcation, and the three glands on one of its branches: (*pg*) poison-gland; (*sg*) marks the upper of the two salivary glands.

Fig. 3. The bifurcation of the duct, with its nucleated hypodermis.

salivary, their secretion diluting the poison. The two efferent ducts, one from each set of glands, carry forward and commingle the venomo-salivary products in the main duct: and the stream is then carried by the main duct to the reservoir at the base of the hypopharynx. There is no other exit for the contained fluid. I see muscles apparently inserted on the frame-work of this reservoir (Fig. 1, *m*); but Dimmock seems to think that the hypopharynx is not furnished with muscles. However this may be, the pressure exerted on it by the surrounding parts, when the mosquito inserts its piercing apparatus into the flesh or through the epidermis of a plant, is sufficient to propel the poison through the tubular axis of the hypopharynx into the wound. The reservoir must be furnished with a valve to prevent the reflux of the secretion. The distal orifice of the hypopharynx is not exactly terminal, but sub-apical, as is usually the case with fangs; the very tip is somewhat flattened and sharp, so as to enter easily into and to enlarge the wound made by the adjoining organs.

Careful observations are needed as to the behavior of mosquitoes on plants; as to the condition of the hypopharynx and the glands in the males and in the larvæ. The observations here noted were made on the adult females of Culex (*C. tæniorhynchus* Desv.), and on a species of the allied genus *Anopheles*, which is characterized by its long maxillary palps.

Princeton College, Sept. 18, 1888.

SOMETHING ABOUT CRABS.

BY J. S. KINGSLEY.

CRABBED, crusty, cancer, canker, are terms which at once recall to most persons various disagreeable features and more serious ailments of human beings; to the naturalist they at once suggest the crabs and the group Crustacea to which these animals belong. There must be some reason why the crabs have thus acquired this bad name which goes even farther than indicated above. They are by common consent regarded as ill-tempered, ready to pinch

upon the slightest provocation, and anything but straightforward in their actions. When a man begins "to crawfish" (the verb is sanctioned by usage, if not by lexicographers) he does not inspire respect. Yet who cannot recall some surly member of the community who is universally regarded as crusty and crabbed, but who, on more intimate acquaintance, reveals another character, quite at variance with the estimation in which he is popularly held? So it is with the crabs. Their crustiness is all external, and if one be willing to run the risk of an occasional nip, he will find that these much maligned creatures have many attractive aspects, and like the rest of nature they amply repay the time spent in their study.

Intellectually the Crustacea are supposed to rank pretty low in the scale, but it is an open question whether this inferiority be an actual one, or whether it results from deficient observation. We can take the ants into our studies and watch their every motion, but the crabs are not so easily domesticated; captivity does not agree well with most of them, and even with those which can be kept, the surroundings are so strange that we have an element entering the psychological equation the value of which it is not easy to ascertain.

Of all the Crustacea with which I have had personal acquaintance, none are more interesting, either in captivity or on their native beach, than the fiddler crabs, those apparently misshapen forms which throng every suitable stretch of sand along our shores from Cape Cod to the Gulf of Mexico. A picture is well in its way to illustrate the shape and general appearance of an animal, but no picture can present to us the animal in action, nor represent its varying moods and phases. The fiddler, with its quadrate body, its eyes seated on the tips of the slender erectile pedicels, those eight slender, sharp-pointed legs, and that enormous pincer, can readily be drawn, but the changing aspects of the body are beyond the artist's power.

When you draw near the beach where these crabs are abundant, no matter how cautiously you have approached, there is a hurried rush of myriads of these crabs, each scuttling away as fast as four pairs of legs will carry it, to a place of safety. At such a time the appropriateness of the common name is seen. In every direction are the fiddlers, each plying its small claw across the enormous fellow in the most amusing manner. No matter how often seen,

one cannot help thinking of the musician—usually bald-headed—away down to the left of the orchestra, who so vigorously saws the bass notes from the viol. Let the latter scamper away, viol and all, as rapidly as does the crab, and the simile would be complete. When, however, you seat yourself and allow the cancrine community to regain its wonted quiet, then you can study these forms to your heart's desire, and see the various occupations. Some are engaged in gathering food, others in building houses. None are idle, but there seems to be no general supervision, each individual following his own inclinations. The holes in which they live vary somewhat with the species. Those on Cape Cod excavate a simple tube leading to a cavity sometimes a foot or two beneath the surface. Further south an allied form appears which arches over the mouth of its burrow with an oven-like roof, beneath the shade of which the proprietor sits and watches for any approaching danger.

These fiddlers are rather remarkable among the crabs in that they live in pairs. Mr. Fiddler is the one who goes about, builds the house, collects the food, and fights the battles and defends the family honor. His faithful spouse is but rarely seen above ground, but what her duties are in her cellar home is a problem yet to be solved. You may at once recognize her by the fact that she lacks the fiddle of her other half. Both of her pincers—hands one might almost call them—are of the same size and resemble the smaller hand of the male, and she uses them indiscriminately in feeding the principal use to which they are put.

The fiddler crabs are usually said to be vegetarians, and, indeed, the greater proportion of their food consists of algæ. They do not, however, confine themselves to this diet, but will eat dead insects or crabs, and, in confinement, they will at times turn cannibals, and prey upon the weaker individuals of their own species. This may be prevented by feeding them often enough and a sufficient amount of vegetable matter. I have had them thrive for months in confinement upon crackers soaked in water, of which, though not their natural food, they appear to be very fond. When thus kept captive they afford very interesting pets, and their actions cause a good many questions. The care is extremely simple. First get your crabs and your jar or box of moist sand, put your

crabs in with the sand and the vivarium is stocked. All that is necessary to keep it in running condition is to occasionally moisten the sand, and to supply new food before the old is exhausted. Kept in this way fiddlers will readily live in confinement through the warmer months, and possibly through the winter as well, though I never tried to keep them so long. I had only male fiddlers, and these I kept in the ordinary glass fruit jars which were half filled with sand. This furnished them endless employment, for they were constantly digging new burrows and filling up those dug but a few hours before. Why this dissatisfaction I am not able to say; possibly it was a case of "Cœlebs in search of a wife."

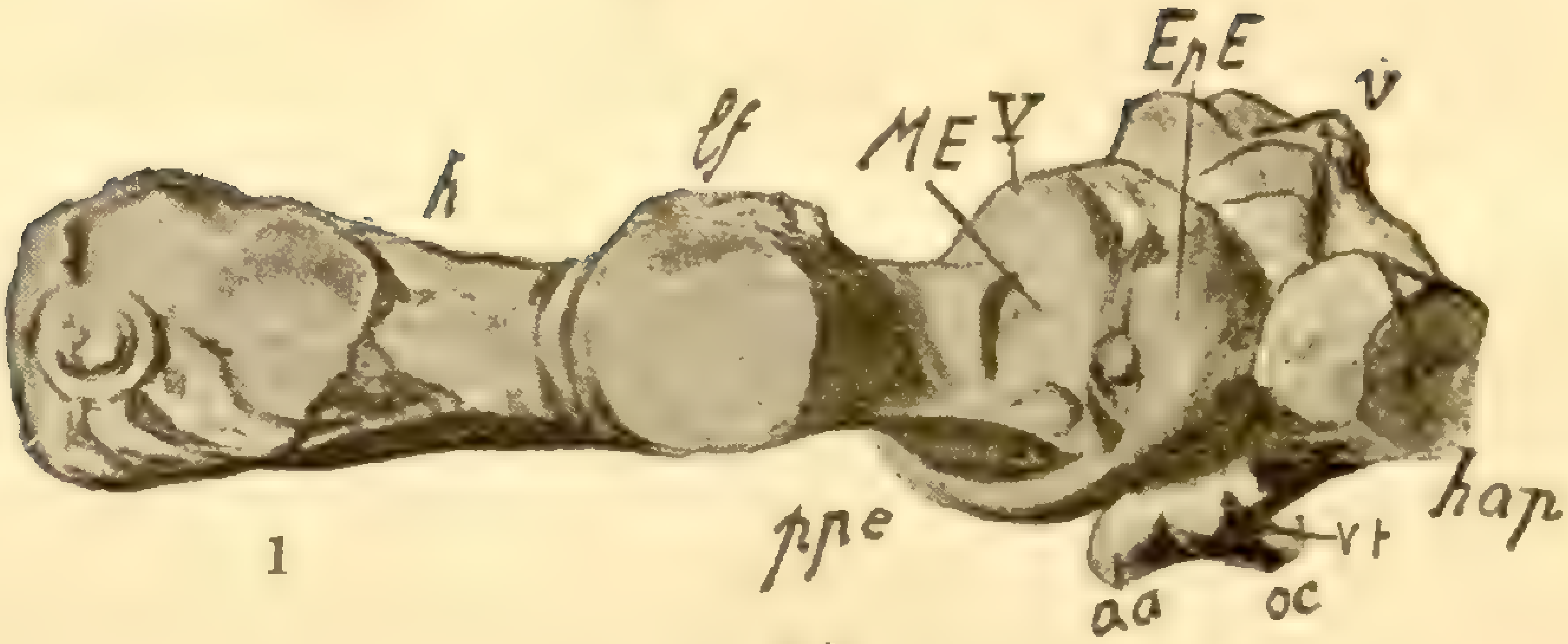
A fight between fiddlers is an amusing affair. When one sees his enemy approaching he immediately puts all his forces on a war-footing. The long-stalked eyes are erected so as to watch every motion of his antagonist; the big pincer furnishes not a bad imitation of the shield with which the soldiers of ancient times protected themselves, while the tension of every nerve is shown in the dainty way in which the eight walking legs trip over the sand, holding the body as high as possible in the air. At last the two meet. There is a clash of arms, each striving to grasp his antagonist and at the same time to protect himself, but might here takes the place of right, and the victor is he who loses the least number of members. There is no surgeon to bind up the wounds, but the amputation of a limb is not such a serious matter here as with human warriors. The yellowish blood which flows quickly coagulates and forms a covering for the wound, and then nature immediately sets about replacing the missing member. The way this is accomplished is so interesting and so different from anything occurring in the lords of creation that it deserves a moment's attention.

The crabs are covered with a hard and unyielding armor which does not admit of growth. So at intervals they shed their shell, and then form a new and larger one, which in turn will be cast to accommodate still further increase of size. In the fiddler crab the first sign one notices of the approaching molt is a splitting of the integument just where the slender tail (which is kept folded beneath the body) joins to the larger anterior portion.

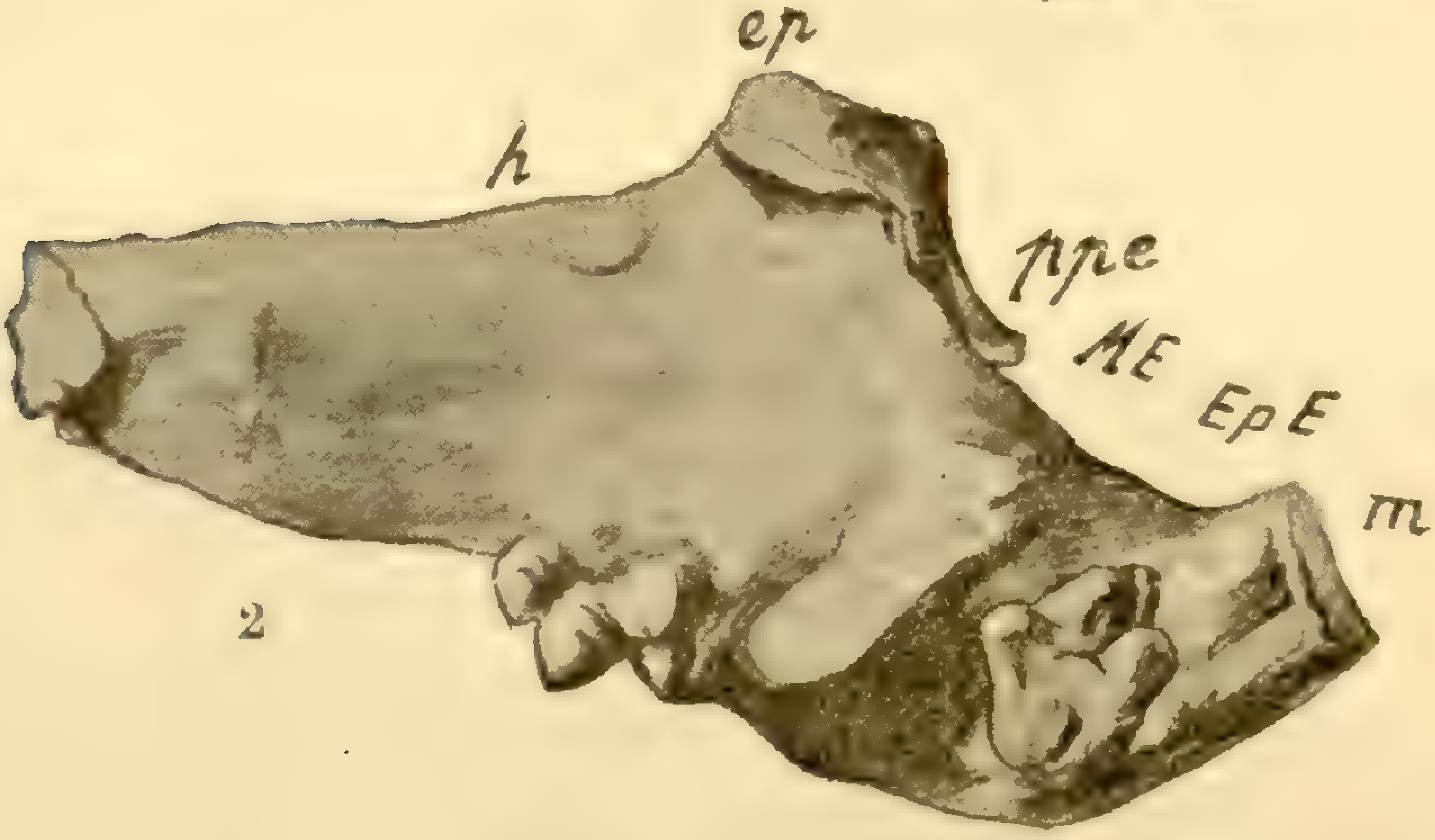
Through the opening thus afforded the crab now withdraws himself, coming forth a soft-shelled, weak, flabby creature. Now he is a pitiable object. The claws, which before could pinch so sharply, are now limp as a rag. His meanest enemy would now find him an easy victim, utterly incapable of the slightest defence. On account of this unprotected condition immediately after molting, all of the Crustacea seek some sheltered spot when about to cast their skin, and hence the operation is not often seen. The process has its differences in the different species; thus the shell of the lobster splits down the middle of the back, while that of the horse-shoe crab splits around the sharp front edge, so as to afford the opening through which the animal is to emerge.

There are, however, other processes which precede the splitting of the shell, which need to be mentioned, and which, as they have been most studied in the lobster, will be described as they occur there. First a word as to the nature of the shell. It is what is called a cuticular product. That is, it is not composed of cells like the rest of the body, or like the skin of man, but of a peculiar substance secreted by the cells lying beneath. Its density in various species differs not only with the thickness of this layer, but as well with the amount of carbonate and phosphate of lime which is deposited in it. It is this outer non-cellular layer which is cast at each molt, while the cells secrete a new shell. If one examines closely any crustacean they will see (more numerous and larger in some places) that all over the body there are small hairs, but these hairs differ from those of man in that they consist of the same cuticle as the rest of the body, and have an axis cylinder which arises from the cell beneath. It may also be said that these same hairs are organs of sense. One of the first preparations for a molt is the formation of new hairs and a new cuticle beneath the old one, and these new hairs have to lift and tear away the shell from the underlying shell. It is an interesting fact that in certain reptiles which "shed their skin," there are bristles which lift the old integument in the same way. Another feature to be noticed is the way in which the lobster withdraws its big claw, and probably the same is true of the fiddler, though this is mere surmise. If we examine a lobster we find that the pincer is much larger than the joints which connect it with the body, and it seems impossible that

PLATE XVI.



1



2

3

Cast of brain-case of Diadectes sp.

Figs. 1 and 2. Cast of cranial cavity, natural size. As the basicranial axis is lost, the inferior outline posteriorly is provisional only.

Fig. 1, from above.

Fig. 2, from the left side.

Fig. 3. Skull of *Diadectes phaseolinus* Cope, from above.

he large muscles which close the pincers can pass through the small flattened rings of the intermediate joints. However, a change takes place in these before molting. There is an absorption of the calcareous matter on the inner surface of these joints, so that they lose their former rigidity and allow the passage of the parts beyond them. In this connection mention may be made of the "crab-stones"—small calcareous bodies occurring on either side of the stomach in Crustaceans about to molt. Although no definite knowledge exists as to the purpose of these masses of lime, it seems probable that they are stores which are to be drawn upon in hardening the new shell. Huxley thinks that this cannot be the case, because these bodies are of inconsiderable size in the crayfish, an argument of but very little weight.

But we are wandering afar from our subject—the way in which lost parts are reproduced in the crabs. Until a molt occurs the wounded veteran has to wander about without the limbs lost in battle, thin stumps seared over by the film caused by the coagulated blood. When the molt takes place we see a change. In the place of the lost leg there rapidly expands a new limb, which is like the old one in all respects except size. It is much smaller, but at the next molt it becomes as large as its fellow. A curious feature connected with the molting is that the lining of the stomach is cast at the same time with the outer shell.

We have explained above the reason why the fiddler crab has received its popular name, but he is in reality a true fiddler. Like many other crabs he has a means of making a noise, and the big claw is his musical instrument. On the inner surface of this member is a row of small rounded tubercles (their position varies with the species), and these can be rubbed against the edge of the shell, producing a note best likened to that caused by rubbing a quill toothpick over a file.

There are other crabs concerning which the popular literature is much greater than that relating to the fiddlers. Possibly more has been written about the hermit crabs than about any others, for certainly no one ever visited the shore without noticing these curiosities. They occur in all seas from the tropics to the poles, but wherever found all exhibit that common characteristic which has given them their name. We have all heard of that old Greek

Diogenes, who made his home in a tub, or, as others will have it, in a cracked amphora, and is it to be wondered that while naturalists were ransacking all ancient history and mythology for names, that the old philosopher should have to furnish a cognomen for some of these, his prototypes? A hermit crab needs protection for the hinder part of his body, for this is covered with a delicate cuticle and could be easily injured. The desired security is sought by inserting this "tail" in the cast-off shell of some univalve mollusc, the curl of the tail and the rudimentary limbs with which it is provided serving to hold the shell tight, and thus protected the hermit wanders over the bottom or along the beach safe from almost any enemy. The little hermits have small houses; the large ones have their larger cells into which they can retire for protection, and, who can say, not for meditation and prayer?

The house-hunting adventures of the hermits have been so frequently described that a repetition is useless. When the body grows too large for the old home a new shell is sought, its dimensions are carefully measured by claws and antennæ, and, if it be thought suitable, moving takes but an instant of time, and the hermit is in a new and larger home. All hermits, however, are not troubled with this frequent recurrence of moving day, for they have living homes, the growth of which is sufficient to accommodate their usual increase in size. They start in life with a borrowed shell, just as do their more familiar cousins of the shore, but a sea anemone helps them later. This latter animal becomes attached to the shell, feeds upon the crumbs dropped from the hermit's table, and grows as he grows. Soon the shell is covered, and then the anemone begins to spread and thus builds a tube for the crab. It goes further, for it absorbs the old shell, and with its own body gives all the protection which the crab needs. Thus the strange partnership goes on; the crab providing food—at least in part—the anemone furnishing the protection. In this respect the latter is far more efficient than the first glance at its soft and skeletonless body would indicate, for it is provided with stinging organs of no mean order, and many a fish is deterred from swallowing crab and all by the nettling it receives from this soft-bodied flower of the sea. A few years ago but a few of these cases of association of hermit crab and sea anemone were known, but more lately the deep-sea dredgings have furnished numerous examples.

This association of forms, which is known as commensalism—a term, a free translation of which would be fellow-boarders—receives numerous exemplifications among the crabs. One form, first described from the Pacific ocean by the late Dr. Stimpson, settles down upon a piece of growing coral, which then proceeds to build a protecting nest about it, leaving only openings for the ingress and egress of the water bringing food and oxygen to the prisoner. Even more remarkable is the case of the shrimp, which so far has only been found enclosed within the glassy network of that beautiful sponge, the "Venus-flower-basket." So strange was this association that when it was first noticed it was thought that those dextrous fingers of the east, which furnish those wondrous ivory carvings and which fashion those curiosity-exciting mermaids, had placed the shrimps within the sponge, and then had closed the opening so skilfully that the detection was impossible. It would now appear that this is not a counterfeit to be be laid at their doors.

Another strange case of commensalism is furnished by some small crabs which are more nearly related to the fiddler with which we started, and of which the little oyster crab is an example. These crabs live inside the valves of oysters, clams and other molluscs, and in olden times quite a pretty myth grew up about them. The delicate Pinna of the Mediterranean (a bivalve mollusc somewhat resembling our familiar salt-water mussel) was eyeless, and in order to escape the jaws of some wandering fish it had to be told when to close its shell. This position of watchman was filled by the little crab which was constantly on the alert, and which in return for its services was protected by the mollusc. This little crab was called Pinnotheres—guardian of the Pinna—and the same name is embodied in the scientific nomenclature of to-day. Relatives of the oyster crab seek other homes. On our Carolina coast is one which lives in the strong tubes built by one of the worms, while in the Pacific are found others which take up their residence in the posterior portion of the alimentary tract of certain sea-cucumbers or holothurians.

The fiddler-crabs are largely air-breathers. In fact, so long as they are in a moist location, where they are in no danger of drying up, they do not need to actually enter the water for weeks or months at a time. In this respect, however, they are equalled, if not excelled,

by several species (some their near relatives) which occur in tropical countries, the warmer portions of America possibly being their metropolis. These land crabs are strange creatures, which, like their marine relatives, are provided with gills, but which, unlike them, stay away from the water for months at a time, and which are drowned by submergence almost as quickly as any terrestrial mammal. There is a considerable diversity in their habits. Some frequent the lowlands near some stream or shore, while others, notably in Jamaica and on the Isthmus of Panama, live in the dense damp forests which clothe the highest mountains. They are not easily caught, for they can run with an agility which almost surpasses belief, while their strong pincers have powers of nipping which are not to be despised. Usually but a few are seen at a time, for during the day they rest in their burrows or in holes in the rocks, venturing forth for food only as evening draws near. Once a year, however, they are compelled to visit the shore to lay their eggs. They then appear in incredible numbers, year after year, on almost the same day. They march along in vast armies, turning to neither side for any obstacle, but devouring everything green in their line of march to the sea.

In connection with these terrestrial crabs many interesting physiological experiments are yet to be made. Years ago it was noted that besides the gills, the gill chamber contained a very thick and spongy lining membrane, which was of use in respiration, and several years later Professor Semper made similar observations upon an East Indian species, in which he recognized not only the spongy layer, but also ascertained that it was richly supplied with blood vessels; in short, that this organ, so far as function was concerned, is a veritable lung, though of course of a far different origin from that of the higher vertebrates.

SCIENCE-TEACHING IN THE SCHOOLS.

BY WM. NORTH RICE.

[Continued from page 774.]

BUT many who concede theoretically the desirableness of the study of natural science in the lower schools, maintain that the practical difficulties in the way of its introduction are insuperable. It is objected that we have no competent teachers, no adequate material facilities, and no time in the already crowded curriculum. Science-teaching in the lower schools, it is said, belongs to that far-off millennium

> "When the war-drum throbs no longer, and the battle-flags are furled,—

when a constitutional amendment has abolished alcoholic fermentation, and made vice forever impossible,—when governments, no longer compelled to support military, naval, and police forces, can spend the bulk of their revenues on education,—when every primary school can have a well-equipped laboratory, museum, and observatory,—when every primary school teacher is a Ph.D. of a German university,—and when a reformed orthography has added about three years to school life, by obviating the necessity of spending that time in learning to spell. I believe, however, that the reform is thoroughly practicable. My own official duty, as a member of a college faculty and of a city school board, has required a careful study of all parts of the educational curriculum in a thoroughly practical spirit. And I should regard the general discussion I have given as of little value, unless I could propose some definite and practicable measures.

The most serious difficulty in the introduction of natural science into the lower schools is undoubtedly the lack of competent teachers. That the mass of our teachers are incompetent for any very high quality of science-teaching, is a truth as unquestionable as it is melancholy. That much of their teaching will be merely bookish,—that much of it will be so blundering that the scholars will have a good deal to unlearn,—is very certain. This difficulty has

been so strongly felt by many scientific men, that they have despaired of any successful science-teaching in the schools till a new generation of teachers can be raised up. "Better no teaching at all than poor teaching," is the principle on which they feel themselves reluctantly compelled to advocate the postponement of a reform whose need none can feel more strongly than they. But I believe the worst teaching we are likely to get is better than none. Very poor teaching of science will at least serve to keep before the mind of the child the idea that there is an external world which is worthy of attention and study. Better that many errors should be learned, than that the child should grow up without thinking of nature at all. No habitude of mind that is likely to be generated by poor teaching can be so bad as the habitude of stolid indifference which is the natural result of the present system. If we wait for teachers well prepared, before we introduce science-teaching, we shall wait indefinitely. Teachers will prepare themselves after a fashion to teach whatever they are required to teach. No way of making a boy swim has ever been found so effective as putting him into the water.

There are books in abundance (and the number is constantly increasing), from which a teacher possessed of a fair degree of mental activity can get suggestions which will enable her to do a limited amount of science-teaching soundly and well. Paul Bert's "First Steps in Scientific Knowledge" is an admirable guide for teachers of elementary science. Morse's "First Book of Zoology," and Winchell's "Geological Excursions," are books in which acknowledged masters of science have shown how science may be taught to the young. The series of scientific tracts for teachers now being published under the auspices of the Boston Society of Natural History are good, as judged from both the scientific and the pedagogic standpoint. Worthington Hooker's books of science for children, though now somewhat behind the times, are still attractive and helpful books. And the teacher who cannot find something to interest the youngest in Johonnot's series of natural history readers, with their delightful blending of fact and fancy, the science and the poetry of animated nature, is stupid indeed.

The teaching of science in the lower schools can be considerably helped by the teachers in the high schools. In most high schools it is practicable to obtain the services of one or more teachers who

have had some genuine scientific training. Arrangements can be made whereby these teachers can now and then give a helpful lecture to the teachers of the lower schools, or give to those teachers the best kind of an object lesson by teaching a lesson in science to the children in their schools.

The summer schools and seaside laboratories afford the means for teachers whose early opportunities for scientific study were scanty, to gain a sound (though necessarily limited) knowledge of scientific facts and methods. The increasing number and the increasing patronage of such institutions is a hopeful sign. They are destined to be of immense service in improving the quality of science-teaching.

The second objection usually urged against the introduction of science-teaching in the lower schools is the lack of material facilities. The force of this objection, however, vanishes, when it is considered that no one proposes for the lower schools complete systematic courses in science. Such courses wonld indeed demand extensive laboratories and museums. But for somewhat desultory lessons on judiciously selected topics in science, whose aim is primarily to cultivate the powers of observation, and secondarily to afford glimpses of the methods of scientific thought, no extensive material facilities are needed. Many of the most important principles of physics and chemistry can be well illustrated with no apparatus except what can be extemporized. A class of tolerably active boys can collect enough material for biological study as they go along. Many of the most important conceptions of philosophical biology can be illustrated without any specimens which are not everywhere accessible. A boy who has found the elbow, wrist, knee, and ankle, in a cat, a horse, a bat, and a hen, has learned the idea of homology, though he has never compared the arms of a brachiopod with the lophophore of a bryozoan, and never heard of the gastræa theory.

The third objection usually made to scientific study in the schools —the lack of time in the crowded curriculum—hardly deserves an answer. Let the waste of time and mental energy be stopped, which is involved in attempting studies at unnatural times and in unnatural ways, and there will be time enough. Of all economies, the most important is the most neglected—the economy of mental effort. I believe the introduction of science-teaching in the schools will be felt by the pupils as a delightful recreation, rather than as

an additional task; and that the improvement of morale will actually enable the schools to accomplish more in other studies.

It remains, then, to outline briefly the work which may be profitably attempted. In the primary schools, and the lower grades of the intermediate, or grammar, schools, the main objects must be to keep alive the child's curiosity in regard to natural objects, to cultivate the power of accurate observation, and to impress the mind with the idea that nature is worth studying. The attempt to teach any systematic body of facts and doctrines, so far as it is made at all, must be strictly subordinated to these more general objects. Hence it is no matter how desultory the lessons may be, if they tend to keep the mind of the child in loving communion with nature. The pupils should be encouraged to collect and bring to school specimens of all sorts of natural objects. So far as time allows, each specimen should be the subject of a lesson. Judicious questioning should bring out all the facts and phenomena which the child has observed or can observe in regard to the specimen. Then the teacher should add something of explanation or information in regard to the object itself or other related objects. And let questions be suggested now and then, which the child and his elders are alike unable to answer. Thus the child will become early habituated to the complementary truths of the transparency and the unfathomableness of nature. He will learn that he can see into nature a little way for himself, but that beyond his vision stretches a vast unknown. The specimens brought in will be an utterly heterogeneous collection—now a bright-winged butterfly, now a flower, now a plant with insect galls, now a sea-shell brought home from some summer visit to the sea-side, now a lustrous crystal, now a smoothly rounded pebble. All the better. Let the children learn the manifoldness of nature. It will be time enough later for them to survey the fences of systematic definition which man has run through nature's continuous and illimitable fields. Short excursions in the woods and fields (or in the parks which afford almost the only glimpses of nature to the unfortunate children who are brought up in the great cities), and visits to museums, zoological gardens, and menageries, will be helpful supplements to the work of the school-room.

Besides the utterly desultory lessons already considered, a beginning may be made in the primary schools in somewhat more sys-

tematic teaching. The objects most interesting to children are living things—plants and animals. Botany and zoology should accordingly be the principal subjects in the science-teaching in the lower grades. The comparison, drawing, and description of various forms of leaves, will furnish delightful occupation and valuable discipline for the youngest children. A little later the more easy and conspicuous flowers can be studied, and later still the more obscure and difficult flowers. In zoology, attention should be given not to crinoids and hydroids and infusoria, but to the mammals and birds and reptiles and fishes and insects which the children can see alive. In places immediately on the sea-shore, some of the more conspicuous marine animals may advantageously be included. The most common and familiar mammals, as cats, dogs, horses, rats, should be first studied; and rudimentary ideas of homology and teleology and the principles of classification can be developed in the study of these most familiar objects. From mammals the study may proceed in later years to birds, and then to the less familiar lower classes of vertebrates, and later still to arthropods and molluscs. Along with the change of subjects, there will naturally be somewhat of a change of method. There will be less of simple observation and description of external characters, more explanation of anatomy and physiology, and more discussion of general relations.

In several of the States, laws have been passed, requiring in all the schools instruction in physiology and hygiene, with special reference to the effects of stimulants and narcotics. There has been an element of fanatical exaggeration in the philanthropic agitation which has led to such legislation, and some of the books which have been prepared, and some of the teaching which has been done, in obedience to the demand, have not been of great scientific value. I believe, nevertheless, that simple lessons in physiology and hygiene may with great advantage be commenced in the primary schools. It is indeed true that physiology can be taught only in a very unsatisfactory manner to pupils ignorant of chemistry and physics, for physiology is essentially chemistry and physics applied to the complex structures and actions of the living body. But very imperfect knowledge is better than absolute ignorance. And the immense importance of the subject, in connection with the fact that only a very small minority of the pupils will ever reach the

high school, more than justifies the attempt to teach some rudiments of physiology in the lower schools.

Somewhat of physical geography will naturally be taught in the higher grades of the primary, and the lower grades of the grammar, schools, in connection with the general course in geography. It is very gratifying to observe the change in the school manuals of geography within the last few years, in respect of the greater prominence given to physical geography.

In the higher grades of the grammar schools, it may reasonably be assumed that the reasoning faculties are more fully developed than in the lower grades, and observation and description of forms may rightly give place in large degree to studies in which the relation of cause and effect is emphasized. This will be the most convenient period for the introduction of exceedingly elementary courses in physics and chemistry. The pupils who will never enter the high school ought to get some rudimentary knowledge of these sciences; and a like rudimentary knowledge obtained in the grammar school will be of great advantage to the students in the high-school course. Of course, at this stage it will not be desirable or possible to penetrate into the mysteries of polarized light, to enumerate the scores of rare elements, or to discuss the more intricate problems of the chemistry of the compounds of carbon. But it will be possible, in the later years of the course in the grammar school, to learn some of the more important facts and principles in regard to gravitation, the mechanical powers, the simpler and more obvious phenomena of sound, light, heat, and electricity, the distinction between elements and compounds, combustion, the chemistry of air and water, and the properties of a very few of the most important elements and their compounds.

When the student reaches the high school, he will be possessed of some knowledge of the forms of common animals and plants, the structure and functions of his own body, and the general properties of matter. What is more important than any knowledge of nature which he may possess—he will have kept himself in sympathetic communion with nature; he will recognize nature as a worthy object of study; he will know that he can learn something himself by the observation of nature, but that he has learned only an infinitesimal part of what nature has to teach. His conceptions will be crude, indefinite, inaccurate. His knowledge will require

elaboration, systematization, correction. But he will not find the book of nature written in a language whose alphabet he does not know. As he comes to the systematic study of the various sciences he will not feel that utterly bewildering sense of strangeness with which teachers in our high schools and colleges are now so sadly familiar. In the high school, he will come under the instruction of teachers possessed of larger knowledge, and supplied with more extensive material facilities. Now then the time has come for *systematic* teaching of science. Random observation and desultory stories of nature must now give place in large degree to the presentation of systematized bodies of fact and theory.

With the beginning of the high-school course comes the separation between those who are preparing for the classical courses in the colleges, and those who are destined to go from the high school directly into practical business life. For the former class the systematic study of science may be mainly deferred until they can enjoy the larger material facilities afforded by the laboratories, museums, and observatories of the colleges. I believe, however, that the complete exclusion of scientific studies from the classical courses in many of our high schools is greatly to be regretted. There are three scientific studies which I would have placed early in the high-school course, and required of both the English and the classical students.

First in this list I would name phænogamic botany. There is no study which can conveniently be made to furnish so admirable a discipline in observation. The material is everywhere accessible in abundance. The collection and dissection of the specimens involves no infliction of pain upon sentient creatures. The débris remaining after a lesson is comparatively clean, inodorous, and wholesome. In all these respects phænogamic botany is better adapted for thorough practical study at this stage than any branch of zoology. The structures which are to be examined in the analysis of flowering plants are also of about the right size to afford the most valuable discipline in accurate observation. The work is neither too easy, nor too difficult. It requires the use of the inexpensive simple microscope, but not the use of the costly compound microscope. A thorough training in plant analysis at this period of the educational course will afford a mental discipline which can be supplied in no other way.

Secondly, I would require of all students at this stage the study of human physiology. The immense practical importance of this branch of knowledge is a sufficient reason for this recommendation. The outlines of physics and chemistry which I suppose to have been taken in the later years of the grammar-school course, will enable the teaching to be more thoroughly scientific in method than can be the case in the lower schools. And, while the study cannot be made so much of an observational discipline as botany, there is no lack of material for demonstration. Most of the organs of the body present the same general character in other mammals as in man. Hearts, lungs, brains, and eyes can readily be obtained from the butchers, and a superfluous cat can be occasionally sacrificed. And, with the various convenient guides to mammalian dissection which have been published, there is no reason why a high-school course in physiology may not be illustrated with a fair amount of demonstration.

Thirdly, a systematic study of physical geography will be invaluable in giving the student an appreciation of the world as a whole —its unity in variety—unity of law amidst endless diversity of phenomena. No study so opens to the student's intelligence the language of nature, teaching him to read the lessons written in the ever varying landscapes which he may from time to time behold.

It is, in my judgment, greatly to be desired that these studies should be included in the requirements for admission to the colleges. As students naturally desire to enter college as early as possible, there is a strong tendency for the preparatory schools to exclude from their classical courses everything not required for admission to college. The requirement of a small amount of natural science by the colleges would greatly favor the progress of the reform in the schools.

For the students in the high school who are not in the classical course, there should be in addition systematic studies of physics, chemistry, zoology, geology, and astronomy. For them, natural science should certainly be a required study during the whole of the high-school course.

While the study of natural science has been advocated on the twofold ground of its practical and its disciplinary value, it has been assumed in this discussion that these two objects are by no means of equal relative importance in the study of different branches

of science or in different periods of the educational course. The study of botany has been advocated especially for its disciplinary value, that of physiology especially for the utility of the knowledge which is acquired. It has been maintained that in the primary school the main objects of the science lessons must be to cultivate a habit of accurate observation and intelligent appreciation of nature, while in the high school each science should be taught as a systematic body of fact and theory. This leads us to notice the unfortunate truth that the two objects of scientific study are to a certain degree incompatible with each other—that the best methods for mental discipline are not the best methods for the acquisition of information. Undoubtedly the method by which the characteristic mental discipline of scientific study can be most effectively secured, is to put the student as nearly as possible in the attitude of the original investigator—to lead him to infer laws and principles from the observations and experiments which he has made himself. But the path taken by the original explorer of a country is often not the most convenient route for subsequent travelers. And a knowledge of laws and principles in science once ascertained can often be taught in ways far more expeditious and convenient than the method of their original discovery. Moreover, many of the most important conclusions rest upon observations only possible in exceptional conditions of time, place, and circumstance. Every student should learn the laws of definite and multiple proportions, which form the foundation of chemical theory; but the ordinary student has no time to perform such a number of experiments in quantitative analysis and synthesis as would make a sound inductive basis for those laws. Every student should learn something of the phenomena and laws of earthquakes and volcanoes; but it is impossible to get up an earthquake or a volcanic eruption for a laboratory experiment. It is well for every student to learn something of the conclusions in regard to the action of the stomach reached by the classical observations on poor Alexis St. Martin; but it is hardly desirable to repeat St. Martin's accident and injury for the benefit of every class in physiology. The right method of scientific education must be a compromise. The most important facts and principles must be taught by text-books and lectures, in such way as to secure most effectively their being understood and remembered. But, so far as the nature of the sub-

ject and the time and means at the disposal of the teacher may allow, mental discipline must be secured by having the student tread for himself the path of observation and experiment, comparison and inference.

This difficulty in science-teaching is somewhat relieved by the consideration that a single fact learned by actual observation or experiment, serves to render real the knowledge of allied facts made known by the second-hand process of description, which would otherwise be shadowy and unsubstantial. The student who has made a few quantitative determinations in chemical analysis, understands the meaning of the analyses which he finds in books. The student who has handled the bones of one animal, can read intelligently the description of other skeletons.

In conclusion, I would most emphatically repeat that a plea for the study of natural science is not a plea against other studies. All the studies which have a place in the educational course, have their place by reason of their capacity to afford sound mental discipline and useful knowledge. All true education is broadening and liberalizing in its tendency. Whatever the special studies which natural tastes or professional plans may lead the student to pursue in the later years of his educational course, or whatever the pursuits in which he may engage after leaving school, he will have learned, if rightly taught, an appreciative respect for all the great branches of study in which the human intellect has engaged. He will not despise the study of languages, bringing him into communion with the great minds of other ages and other nations; nor the study of language, interpreting the structure and development of earth's myriad tongues. He will feel the dignity of that pure truth which is embodied in mathematics, and will appreciate the immense utility of the applications of mathematics in the arts of a material civilization. He will have learned in due time that he has a soul as well as a body; and will appreciate the study of the human mind, as revealed to the direct gaze of consciousness, or as expressing itself in literature and history. And the double world of sensation and consciousness will disclose to him its highest meaning, in the revelation of Him

> "Whose dwelling is the light of setting suns,
> And the round ocean, and the living air,
> And the blue sky, and in the mind of man."

But, whatever sources of light may shed their beams upon his advancing intellect, the first star which rose above his horizon will never set. Whatever teachers he may listen to, the one whose gentle voice first roused him from the slumber of unconsciousness will never be forgotten. As his first lessons were from nature's teaching, she will have for his expanding mind lessons continually new. He will

> " Find tongues in trees, books in the running brooks,
> Sermons in stones, and good in everything."

Note.—It is proper to say that the address was not written previously to its delivery before the Society of Naturalists; and that, in writing it in its present form, I have incorporated some ideas which were suggested in the discussion at the meeting, and some which have been the fruit of further reflection. The article is, however, in the main a reproduction of the address as given.

In July, 1888, the Board of Education of the City of Middletown, Conn., adopted a new Manual for the Schools of that city. The new course of study provides for instruction in Natural Science in all grades from the lowest Primary upward, on a plan substantially the same as that which I have recommended. As a sort of practical comment on the views of the address, I append an extract from the Middletown School Manual, giving the instructions to the teachers in the Primary and Grammar grades in regard to instruction in Natural Science. The portion of the Manual here quoted was written by myself in connection with the Superintendent of Schools, W. B. Ferguson, M.A.

Extract from the Manual of the Public Schools of Middletown, Conn.

NATURAL SCIENCE.

Introduction.—The object of elementary lessons in Natural Science is twofold:—to train the observing powers, and to give information. The former should be especially emphasized in the Primary Grades, and the two made about equally important in the Grammar Grades.

The teaching should be chiefly objective. Large, well-defined pictures may be used, whenever it is impossible to obtain the real objects; but it should always be borne in mind that the best pictures are poor substitutes for the objects themselves.

In the lowest grades, the teacher should studiously avoid the use of technical terms, whose meaning is unknown to children. The chief object here is, not to teach science, but to train to close and accurate observation, and to stimulate a keen interest in nature. In no grade should special emphasis be laid upon technical terms and classifications, though somewhat more attention may properly be given to them in the Grammar grades. All classifications should, so far as possible, be the result of observation and comparison on the part of the pupils. Let the teacher stimulate, direct, and name. Happy the teacher and fortunate the pupils, if, in this delightful work, the teacher judiciously combines speech and silence. An occasional talk, however, by the teacher on the subject before the class is both proper and desirable. Such talks should furnish information beyond the reach of the pupils' observation.

Every lesson should be carefully prepared. Aimless and irrelevant conversations are profitless. Allow and encourage the freest expression of what the pupils see. *Encourage the pupils to collect and bring in specimens. Elicit, by judicious questions, a description of what they have brought. Give them additional information. If necessary, postpone the subject till the next day, and learn something about it.*

GRADE I.

Physiology.—Regions of the body—head, trunk, limbs. Details of external parts. Uses of external organs. Hygiene of the skin—bathing.

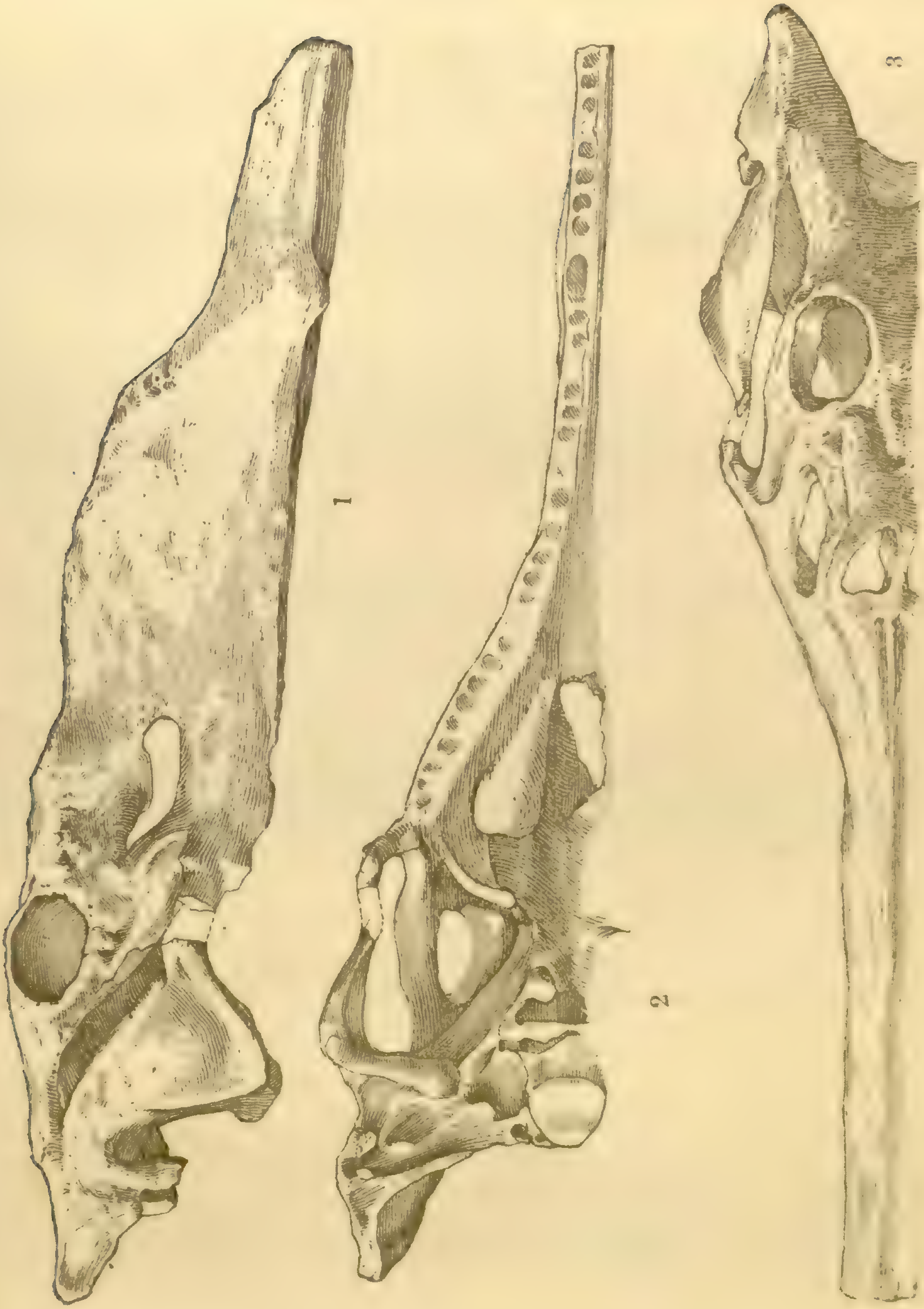
Zoology.—Lessons on common mammals—*e.g.*, cat, dog, horse, cow, rat, squirrel. Let the pupils observe, compare, and describe these animals, as regards their external aspect and habits. Compare these animals with ourselves. Tell stories illustrative of habits of these and other mammals.

Botany.—Lessons on common plants. Teach pupils to distinguish root, stem, leaf. Compare leaves of different plants, as regards general form, margin, venation. Require pupils to draw and describe leaves of many plants.

GRADE II.

Physiology.—The framework of the body. Bones, joints, muscles. Exhibit anatomical diagrams. Teach the pupils to find in their own bodies some of the bones which can be easily felt through

PLATE XVII.



Cranium of *Belodon buceros* Cope, from Southwestern New Mexico.

the skin. Emphasize importance of correct attitudes while the framework of the body is rapidly growing and taking shape. Warn against stooping shoulders and crooked backs. The teeth—their forms and uses. Emphasize importance of proper mastication. Necessity of cleaning teeth.

Zoology.—Lessons on mammals continued. Special study and comparison of limbs of mammals. Let the pupils find the elbow, wrist, knee, and ankle, in the cat, dog, horse, cow, rat, squirrel, and any other mammals of which specimens or pictures may be at hand. Thus teach the idea of homology, though the word should not be used. Compare the teeth of common mammals, and lead pupils to recognize adaptation of different kinds of teeth to different kinds of food. Teach pupils to recognize degrees of resemblance between animals. The cat and the dog resemble each other more than either resembles the horse or the rat. Develop idea of classification. Lead pupils to recognize characters of carnivores, ungulates, rodents. Most of the mammals with which the children are familiar are included in these three orders. But tell them about monkeys and kangaroos and other very different forms of mammals, that they may not suppose that all mammals are so included.

Botany.—Different kinds of stems—woody and herbaceous, exogenous and endogenous. By study of numerous examples lead pupils to recognize that exogenous stems usually bear net-veined leaves, and endogenous stems usually bear parallel-veined leaves. Distinguish deciduous and evergreen trees. Let the pupils make lists of each.

GRADE III.

Physiology.—Elementary ideas of digestion. Why do we eat? All parts of the body are made of the food which we eat. Food is made into blood, and blood made into all the materials of the body. But our food is mostly solid, and must be made liquid before it can get into the blood. Different substances dissolve in different liquids—*e.g.*, salt in water, camphor gum in alcohol, iron filings in dilute sulphuric acid. Show these experiments. Body itself must make liquids which will dissolve food. Put lump of sugar in mouth. Mouth fills with saliva, and sugar is dissolved. This illustrates secretion of digestive fluids. But meat will not dissolve in saliva. What does become of it? Show

anatomical plate of stomach, and tell about gastric juice. Teach (with use of anatomical diagrams) outlines of anatomy of digestive organs. Show by experiment how much more quickly powdered salt dissolves in water than lumps of rock salt. Teach importance of thorough mastication. Show gizzard of turkey, and explain its use. But we have no gizzard; and hence must not swallow our food whole, as the turkey does. Wholesome and unwholesome foods. Alcohol.

Zoology.—Lessons on common birds—*e.g.*, robin, hawk, hen, duck. Let pupils compare these with each other and with mammals. Compare feet and bills of different birds, and show adaptation to habits. Continue lessons on homology of limbs. Let the pupils find elbow, wrist, knee, and ankle, in birds. Is the bat a bird? Talks on instincts of birds shown in periodical migrations and nest-building.

Botany.—Lessons on flowers. Select plants with perfect and somewhat conspicuous flowers. Teach pupils to recognize sepals, petals, stamens, pistils. Let pupils describe and draw the parts in a variety of flowers. Study polypetalous flowers first, afterwards monopetalous flowers. Cut open the ovary in large flowers, and show the ovules. Develop the idea that the parts of a flower are altered leaves.

GRADE IV.

Physiology.—Circulation. When food has been made into blood, blood has to be carried to all parts of the body—function of circulation. Show by anatomical plates the outline of anatomy of circulatory apparatus. Let pupils find some of their own veins, and feel pulsation of heart and of arteries in wrist and temple. Respiration. Show difference between inspired and expired air by experiment with lime-water. Burn a candle in a jar, and show that the air in the jar affects lime-water like expired air. Carbonic acid always formed when carbon burns—*i.e.*, when carbon unites with oxygen. Carbon in body and in food. Carbon burns—*i.e.*, unites with oxygen,—all over the body. Body runs, like a steam-engine, by burning carbon. Object of respiration—introduction of oxygen, and removal of carbonic acid. Anatomy of respiratory organs. Hygiene of respiration—dress, ventilation. Respiration in aquatic animals. Show gills of fish, and respiratory movements in living

fish. Fish breathes air dissolved in water. Show presence of such air by warming a beaker of water, and so forming air-bubbles.

Zoology.—Lessons on common reptiles, amphibia, and fishes—*e.g.*, turtle, snake, frog, perch, pickerel, eel. Let pupils observe, compare, and describe. Continue studies of homology of limbs. How many of these animals have two pairs of limbs like those of mammals and birds? Notice external covering of these animals. Their bodies are cold. Why? Respiration of fishes. Is the whale a fish? Metamorphosis of amphibia, as shown in changes from tadpole to frog. Teach characters of the three classes—reptiles, amphibia, fishes. Characters possessed in common by mammals, birds, reptiles, amphibia, fishes. Sub-kingdom vertebrata.

Botany.—The pistil of a flower developes into a fruit. Different kinds of fruits. Seeds. Show the embryo in beans and other large seeds. Plant seeds in pots, and show growth of plants from seeds. Cycle of growth, reproduction, death.

GRADE V.

Physiology.—Nervous system. Analyze the series of actions when a boy puts his hand on the radiator, and finds it too hot. Nervous system a telegraphic system in the body. Brain the central office. Afferent and efferent nerves. Anatomy of the nervous system. Hygiene of the nervous system—stimulants and narcotics.

Zoology.—Study the lobster. Lead pupils to recognize jointed external skeleton, distinct regions of body, jointed limbs. Trace similarity of structure in feelers, jaws and accessory jaws, nippers, legs, and other appendages, including the caudal fin. Cut off edge of carapace on one side, and show gills. Contrast articulate type of structure, as shown in lobster, with vertebrate type, as shown in animals previously studied. Compare diagrams of nervous systems in vertebrates and articulates. Compare with the lobster, the crab and the sow-bug. Teach pupils to recognize the common characters which unite these animals in the class crustacea. Study angle-worm, as illustrating articulate type in much simpler form—body not differentiated into regions, no jointed appendages. Talks on useful animals.

Botany.—Study more obscure and difficult forms of flowers than those examined in Grade III. Flowers densely aggregated, as in sun-flower, dandelion, daisy. Imperfect flowers, as in wil-

low, oak, chestnut. Flowers with open (gymnospermous) pistil, as in pine, spruce.

GRADE VI.

Physiology.—Briefly review work of previous grades. Special study of the eye. Anatomy of the eye. Illustrate formation of image on retina by use of a large lens. Hygiene of the eye. Injury of eye by use of light too strong, too feeble, unsteady, or improperly placed. Cultivation of near-sightedness by bad positions in reading and writing.

Zoology.—Study common insects, as the bee, butterfly, fly, beetle, squash-bug, dragon-fly, grasshopper. Compare these animals with lobster, sow-bug, and angle-worm, and recognize in all these the common character of articulates. In insects, note the characteristic division of body into head, thorax, and abdomen. Compare wings of insects as regards number, form, venation, texture. Show scales from wings of moth and butterfly under microscope. Examine the mouth parts of those insects which are not too small. Supplement observation with pictures. Under lens examine eyes of insects. Explain their peculiar structure. Metamorphosis of insects. Catch some caterpillars in the fall, and keep them in boxes in the school-room. Some of them will probably survive and appear as moths or butterflies early in the spring. Talks on injurious animals. Show how some animals are useful by destroying injurious animals —*e.g.*, insectivorous birds.

Botany.—Distinction between flowering and flowerless plants. Examples of flowerless plants—ferns, club-mosses, horse-tails, mosses, lichens, fungi, sea-weeds. Show fructification of ferns. Show that the distinction of root, stem, and leaf, so obvious in nearly all flowering plants and in ferns and others of the higher flowerless plants, vanishes entirely in fungi and sea-weeds.

Mineralogy.—Study crystalline form, cleavage, color, lustre, hardness, of some of the minerals common in the vicinity of Middletown—*e.g.*, quartz, feldspar, mica, hornblende, garnet, tourmaline, beryl.

GRADE VII.

Physiology.—Senses of hearing, smell, taste.

Zoology.—Study the river mussel. Direct pupils' attention to shell (with its hinge, ligament, mantle-impression, and muscular impressions), mantle, gills, palpi, mouth, foot, adductor muscles.

Compare this animal with the oyster and the clam. Note that the former has only one adductor muscle; while the latter has the mantle lobes united, forming a sack which is continued posteriorly in the breathing-tubes, or siphons. Examine some pond-snails. These will be found to resemble the preceding in their flabby, unjointed bodies, destitute of internal skeleton; but will be seen to differ in having a distinct head with feelers, and a spiral univalve shell. Examine shells of some of the sea-snails. Lead the pupils to recognize characters of Lamellibranchiata and Gastropoda, as classes of the sub-kingdom Mollusca. Contrast the Mollusca with the Vertebrata and Articulata. Give some talks on corals, sponges, and other animals lower in the scale than mollusks. Do not let the pupil suppose that the classes he has studied comprise the whole animal kingdom. Talks on geographical distribution of animals. Give a little idea of geological succession of animals.

Botany.—Geographical distribution of plants. Uses of plants. Relation of plants to animals.

Geology.—Gravel, sand, clay. Show that these result from the disintegration of pre-existent rocks. Erosion, transportation, and deposition by watér. Study gutters and puddles for illustration of action of aqueous agencies. Conglomerate, sandstone, shale. Show that these result from consolidation of gravel, sand, clay. Visit Portland quarries. Other rocks are sediments not merely consolidated, but crystallized by action of internal heat. Study specimens of gneiss and mica schist. Contrast their texture with that of sandstone and other sedimentary rocks. Still other rocks have come up in molten condition from interior of globe—*e.g.*, lava, trap. Talks on volcanoes.

GRADE VIII.

Physiology.—Review nutritive functions, using elementary text-book. Illustrate subject with a few dissections.

Physics.—Elementary text-book. Illustrate with experiments, as much as practicable.

GRADE IX.

Physiology.—Review functions of relation, using elementary text-book.

Chemistry.—Elementary text-book. Illustrate with experiments, as much as practicable.

THE PINEAL EYE IN EXTINCT VERTEBRATES.

BY E. D. COPE.

THE discovery of the pineal eye in lizards is due to Leydig, who first recognized it as a probable sense organ in 1872. Dr. Graaf first determined its structural correspondence with the invertebrate eye in 1886. In the same year [1] Spencer examined a large series of Lacertilia, and pointed out the very diverse degrees of development of this organ presented by these reptiles. In 1882 Prof. Rabl-Ruckhard refers to the large parietal foramen of Ichthyosaurus and Plesiosaurus as indications of the existence of a pineal sense organ in those ancient reptiles, perhaps especially sensitive to temperature. In the NATURALIST for 1885 (p. 1029), the present writer stated that the Pelycosauria of the Permian epoch possessed large pineal eyes. Mr. Spencer expresses a similar opinion with regard to the extinct Stegocephala or labyrinthodonts of the carboniferous system, in his paper above mentioned. He there maintains also the homology of the median eye of the Tunicata with the epiphysis of the Vertebrata.

In a paper published in the NATURALIST of 1885 (p. 291), the present writer described the characters of the supposed fish *Bothriolepis canadensis*, and homologized the orifice in the superior wall of the anterior part of the carapace (supposed to represent the head) with the orifice or mouth in a corresponding position in the Tunicata, especially referring to Chelyosoma, as having a general resemblance to Bothriolepis. I mention (p. 290) that a plate covers the middle part of this orifice, forming a median valve of the mouth, a character which is also described by Whiteaves in 1887.[2] It was already described in the allied Pterichthys by Pander and Owen. This plate covers the median part of the superior orifice, and leaves the lateral parts open. It has little fixity in the specimens I have examined, for which reason I called it a valve. See plate XV.

Subsequently I described the genus Mycterops[3] from the coal

[1] Mr. Spencer's paper is dated 1885, although he quotes De Graaf's and my own papers published in 1886.
[2] Illustrations of the fossil Fishes of the Devonian Rocks of Canada: Transac. Royal Society of Canada, 1886 (7), p. 102.
[3] American Naturalist, 1886, p. 1029.

measures of Pennsylvania (Plate XV), which is intermediate in the character of the anterior regions between Cephalaspis and Bothriolepis. The median orifice of the latter genus is present, and its middle portion is roofed by a plate. But this plate differs from that of Bothriolepis and Pterichthys, in being perforated by two orifices, which resemble in their position nostrils, while the lateral orifices have the position of the eyes of the Cephalaspididæ.

Under these circumstances the evidence in favor of the orifices in Bothriolepis being eyes, is stronger than that which points to its homology with the mouth of Tunicata. The structure of these primitive vertebrates strongly indicates the origin of lateral or paired eyes from a single median eye, such as is found in the Tunicata, and continues to point to the descent of Bothriolepis from those animals. Mycterops indicates a wider divergence than Bothriolepis; and Cephalaspis a still further stage of modification. Dr. Dollo, of Brussels, has expressed the view that the superior orifice of Pterichthys corresponds with the median eye of the Tunicata and the pineal eye of the Reptilia.

Of course, if the median eye of the Tunicata became specialized into the lateral eyes of higher vertebrates, it might seem improbable that it could be at the same time homologous, as there are no embryological reasons for refusing to believe (Spencer), with the pineal eye of the same forms, which possess also the lateral eyes. It may not be impossible, however, that this is really the case, and that the paired eyes, as well as the pineal eye, have been formed by evagination of differentiated parts of the Tunicate eye, so that the views of Lankester and Spencer may be both correct. The formation of the lens from two parts in the Tunicates, which precludes its correspondence with the pineal lens in Reptilia, probably has a significance in this connection, expressing the origin of the lateral eyes, while the retinal portion is homologous with the pineal retina.

In extinct American Batrachia the parietal.foramen is wanting in Eryops and Zatrachys, and has not been observed in Trimerorhachis; but it is well developeds in Cricotus, the genus that leads probably to the Reptilia.

Among North American extinct reptiles I have described the characters [1] of the cast of the brain case in two widely distinct forms.

[1] Proceeds. Amer. Philos. Soc., 1886, p. 234.

These are Diadectes,[1] a Permian genus of Theromora, and Belodon, a Parasuchian crocodile. The former has an immense parietal foramen, while the latter has none. The general characters of the brain in Diadectes are as follows: The widest part is at the origin of the trigeminus nerve. Both the cerebellum and nesencephalon are flat, and simple. The hemispheres are narrower than the segments posterior to them, and of greater vertical diameter. The epiphysis is enormous, and its flattened posteriorly extending peduncle is very distinct. The olfactory lobes were apparently large, and had a greater transverse diameter than the hemispheres. The reduced diameter of the hemispheres is a character of fishes and Batrachia rather than of reptiles, but the thalami are also smaller than is the case in Batrachia. The small, flat cerebellum is rather batrachian than reptilian. (Plate XVI.)

There is some reason to suspect that the Diadectes relied exclusively on the pineal eye for the sense of sight. The species of the family were subterranean in their habits, since their humeri indicate great fossorial power, resembling those of the existing monotremes, and even the mole. The vertebræ are locked together with the hyposphen beside the usual articulations, and the arches of the neural canal form an uninterrupted roof from the skull to the tail, of extraordinary thickness and strength. That the species are not aquatic is rendered probable by the fact that the orbits do not look upwards. Their superior borders are, on the contrary, prominent and straight. Add to this fact the apparent absence of optic foramina, and the probability that the Diadectidæ were blind and subterranean in their habits becomes still stronger.

Belodon is a genus of reptiles which belongs to the sub-order Parasuchia of Huxley, which has been generally associated with the Crocodilia. It is characteristic of Triassic formations. Three species have been found in Europe, three in Eastern North America, and two in the Rocky Mountain region. One of the latter, *Belodon buceros* Cope, is represented in Plate XVII. It was about as large as the Gangetic gavial. As in Crocodilia generally there is no parietal foramen. Differently from crocodiles of later ages, the nostrils are posterior in position, and near the orbits, so that the nose might be plunged deeply beneath the surface of mud or water without inter-

[1] Loc. cit., 1887, p. 219.

EXPLANATIONS OF PLATES.

PLATE XV.

Fig. 1. Shell of *Bothriolepis canadensis* Whiteaves, from above. (From Whiteaves.)

Fig. 2. Anterior part of same, from below. (From Whiteaves.)

Fig. 3. Skull of *Mycterops ordinatus* Cope, from below, $\frac{2}{3}$ natural size.

PLATE XVI.

Cast of brain-case of Diadectes sp.

Figs. 1 and 2, cast of cranial cavity, natural size. As the basicranial axis is lost, the inferior outline posteriorly is provisional only.

Fig. 1, from above.

Fig. 2, from the left side.

Fig. 3, skull of *Diadectes phaseolinus*, from above.

The letters signify as follows: *m.*, medulla; *cb.*, cerebellum; *opl.*, optic lobe; *ep.*, epiphysis; *ppe.*, posterior process of epiphysis; *lf.*, lateral foramen; *h.*, region of cerebral hemispheres; *v.*, cast of vestibule.

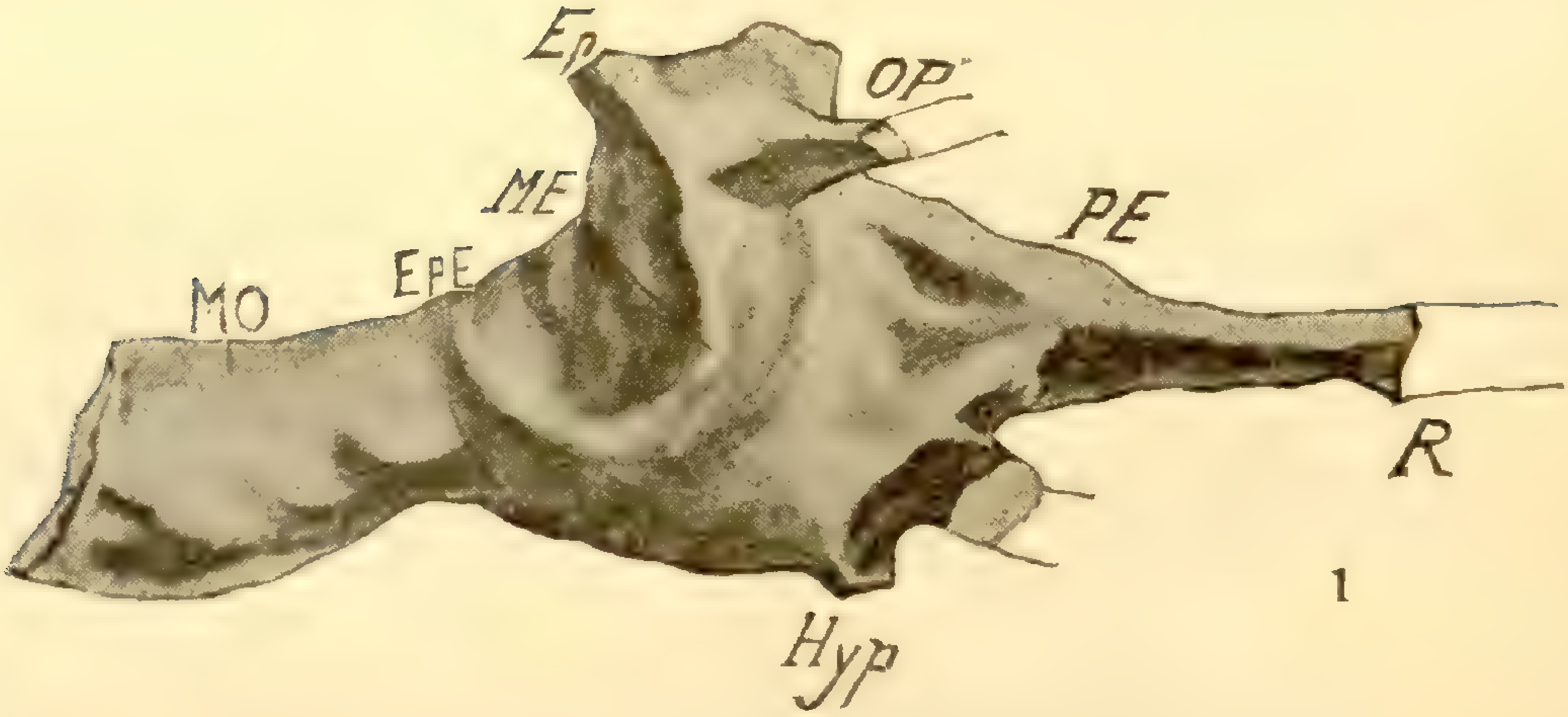
PLATE XVII.

Cranium of *Belodon buceros* Cope, from Southwestern New Mexico, from which the following cast was taken; one-fourth natural size. Lateral, and one-half inferior and superior views.

PLATE XVIII.

Cast of brain-cases of *Belodon buceros* and *Alligator mississippiensis*, natural size. Figs. 1–3. *Belodon buceros.* Figs. 4–5. *Alligator mississippiensis.* Fig. 1. Right side. Fig. 2. Superior surface. Fig. 3. Right side. RE. Rhinencephalon. PE. Prosencephalon. ME. Mesencephalon. Ep. E. Epencephalon (Cerebellum). MO. Medulla oblongata. Ep. Epiphysis. Hyp. Hypophysis. ii. Optic nerve; v. Trigeminus; vi. Abducens; vii. Facialis; viii. auditorius. Op. Orbitopineal process or nerve.

PLATE XVIII.



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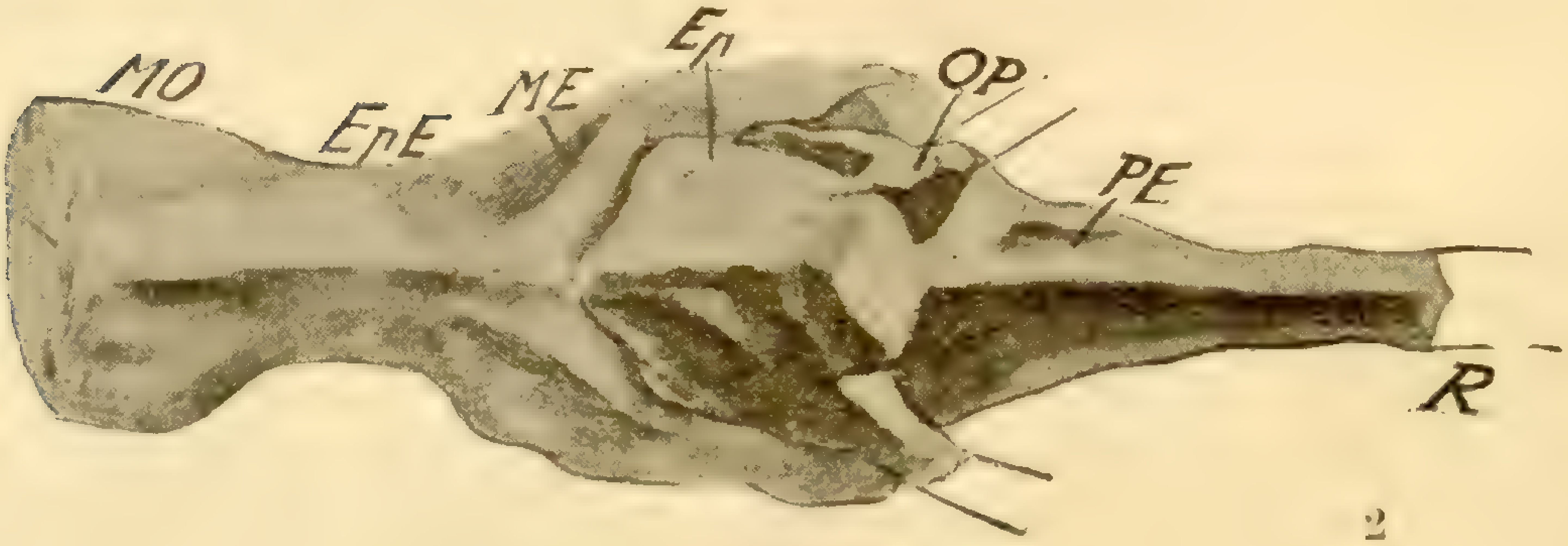

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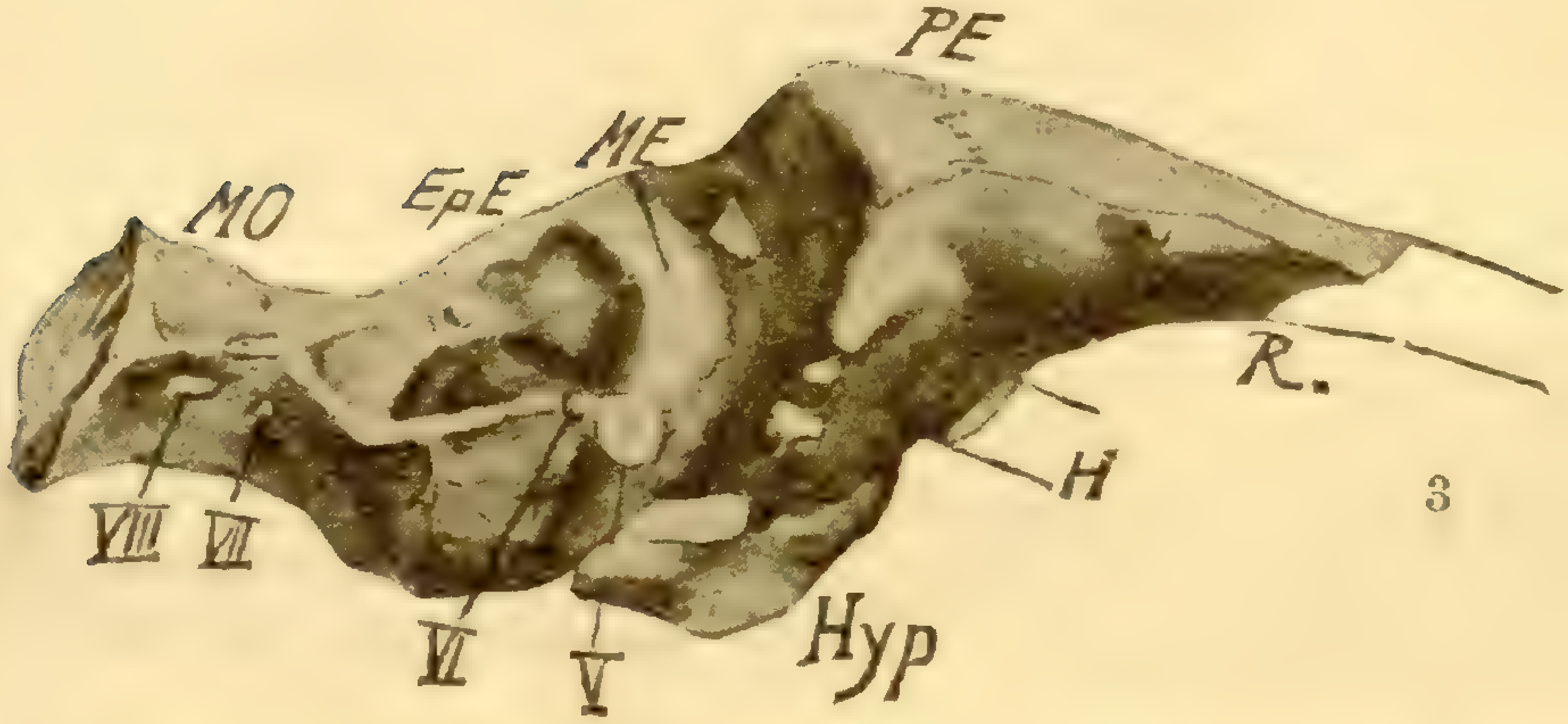

3

Cast of brain-cases of *Belodon buceros* and *Alligator mississippiensis*, natural size. Figs. 1–3. *Belodon buceros*. Figs. 4–5. *Alligator mississippiensis*. Fig. 1. Right side. Fig. 2. Superior surface. Fig. 3. Right side.

fering with the respiration. The characters of the brain are as follows:

The first point which arrests the attention in making a comparison with Diadectes is the similarly huge size of the epiphysis in the two types. A foramen on each side of the base of the epiphysis in the Diadectes gave exit to a process similar to that which enters the orbitopineal canal in the Belodon, and which I called the lateral process of the epiphysis in the latter. Plate XVIII, figs. 1–3, 1 f). The processes are probably homologous in the two genera, but in the Belodon they extend through the posterior wall of the orbit, filling a large canal. There is little resemblance between the two brains in other respects, but they agree in the small size of the prosencephalon, and in the complete enclosure of the rhinencephalon by osseous walls. In the Diadectes there is no optic foramen, but a huge trigeminus; in Belodon, an optic foramen, and a very small trigeminus.

The presence of such a huge epiphysis in the Belodon, as compared with its very small size in modern crocodiles, is a point of much interest, and points to its inheritance from the reptiles of the Permian. But if, as is probable, it contained the pineal eye, the latter could not receive light directly from above, since the parietal foramen is wanting. The presence of a communication with the orbit becomes interesting in this connection. A minute foramen passes from the base of the rhinencephalon into the orbit in the alligator, but the homology with the *canalis orbitopinealis* of Belodon is by no means made out. The *nervus orbitopinealis* may have supplied the lack of light due to the closure of the parietal foramen, but in what way we are left to conjecture.

The equality of size of the brain of the Belodon to that of the existing alligator is a point of interest.

The Belodons were probably aquatic reptiles, living on the shores of estuaries like modern crocodiles, and were of carnivorous habits.

EDITORS' TABLE.

EDITORS: E. D. COPE AND J. S. KINGSLEY.

Economy pushed to its extreme becomes niggardliness. The appropriation for a Governmental Zoological Garden at the Capital has been defeated in the House of Representatives, not because of any objection to the proposition, to the location, to the site, nor to the necessity, but solely because of the money it would cost. It was simply the wail of a miser. The benefit from, in fact necessity for, a Governmental Zoological Garden was conceded. The time and opportunity were *apropos.* It was not denied that the management was in proper hands. No argument was made against the project save that it would cost money, and this was played *ad nauseam.* The opponents of the project raised their voices and fairly wept over this great expenditure of money.

We attempt no homily on the duties of a legislator, nor to explain how it is sometimes as much his duty to spend money as it is at others to save it. The United States, with a greater territory, greater riches, and with undoubtedly greater opportunities, is behind third and fourth-rate kingdoms in the matter of zoological gardens. The *Materiaux pour l'historie de l'Homme* for August has an article entitled "Extinction of the Buffalo," in which it notices a capture or massacre, in the Territory of Arizona, of a herd of buffalo (*Bos americanus*), and says, "The race is now practically extinct." It laments that these are not the only zoologic forms in America which have become so, and closes, "The Republic of the United States of America is less careful of its opportunities, and pays less regard to its duty to science than does the Russian Empire, where the European bison of pre-historic times lives under the protection of the Czar."

If the two or three gentleman who led the opposition, and the fifty-six members who voted with them, shall continue the defeat of the project, and thus the buffalo become an extinct animal, with others now threatened, the descendants of these gentlemen will have little cause for pride in this act of their ancestors.

There never will be a time when this project can be carried out

more opportunely than at the present. Each year that it is postponed increases the expense. Many people stand ready now to aid it with contributions of animals. If a place were but provided in which the animals could be kept and cared for, the Garden would soon fill up. But with the passage of time these opportunities will also pass, and the difficulties and expense correspondingly increase.

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GENERAL NOTES.

GEOLOGY AND PALÆONTOLOGY.

Variations of Gravity in Approaching the Centre of any Cosmic Sphere Whatever.—First, within a hypothetical hollow sphere, the solid shell of which is, in all parts, of equal density and of equal thickness, gravity at every point is in absolute equilibration. This results from two laws. First, gravity, relative to the same kind of matter, varies directly as the quantities. Let Q equal one quantity and q equal another; and G equal the gravity of Q, and g equal the gravity of q: then will Q : q : : G : g, and there results $Q \times g = G \times q$, or $g = \frac{G \times q}{Q}$.

Now, if, in our hypothetical hollow sphere, we assume any point whatever, and draw a line through that point to the nearest and most distant points of the shell, this line will be a straight line, and the longest that can be drawn in the sphere; hence it passes through the centre, and is the diameter. Now, pass a plane through this assumed point and perpendicular to the diameter, cutting the shell into two segments, corresponding to the two segments of the diameter made by the assumed point.

Let R equal one segment of the diameter, and r equal the other; let Q equal the segment of the shell corresponding to R, and q equal the segment corresponding to r: then, since, by hypothesis, the density and thickness are everywhere equal, there results $Q : q :: R^2 : r^2$, and $Q\ r^2 = q\ R^2$; but gravity varies in proportion to the duplicate ratios of the reciprocals of distance, R and r. Let G represent the gravity of the segment $R^2 \times q$, and g represent the gravity of segment $r^2\ Q$, at the assumed point, then we have $G : g :: \frac{1}{R^2 q} : \frac{1}{r^2 Q}$; therefore, $G\ R^2\ q = g\ r^2\ Q$. Now, since $Q\ r^2 = q\ R^2$, $G = g$: *i.e.*, gravity, at any point whatever, in this hollow shell, is in absolute equilibration. Hence, in approaching the centre of any cosmic sphere, any point is in equilibration, relative to all the external shell; and gravity at any point is determined by the mass of the internal sphere, measuring from the point assumed to the centre for the radius of the internal sphere.

But the masses of spheres are directly proportioned to the triplicate ratios of their radii. Let R equal the radius of the cosmic sphere, and r equal the distance from the point assumed to the centre, *i. e.*, radius of the inner sphere. Let G equal the gravity on the surface of our cosmic sphere, and g equal the gravity at the point assumed: then will result $G : g :: R^3 : r^3$; $g = \frac{G\ r^3}{R^3}$. At the centre r equals 0 and $g = 0$. They vanish together.

As a matter of fact, however, this proportion and equation are true for two points only: viz., at the surface, when $R = r$, and at the centre, when $r = 0$. Why? Because the density varies with the pressure, in the first place. Though the weight, *i.e.*, the gravity, relative to that sphere alone, is greatest at the surface, in the case of any given quantity of matter, yet, under the superincumbent pressure, the density of the inner sphere, composed of the same matter, is greater than that of the entire sphere.

Again, the heavier matter, *i.e.*, the matter of the highest specific gravity, during the process of free centralization, naturally forms the nucleus of the sphere, throwing the lighter materials to the surface, as we see in case of our earth. Thus, for two reasons, the

centres of all cosmic spheres are of higher specific gravity than the surfaces. On the contrary, after solidification has taken place, by virtue of thermal radiation into the infinite of space, the high degree of internal heat tends, very considerably, to diminish the density of the interior.

The complexity of this problem is not amenable to mathematic resolution. Even the elastic resiliency of the most persistent gases increases more rapidly than any assumed amount of pressure. Thus, if the pressure increases as the natural series 1, 2, 3, 4, etc., the elastic resilience is such that the resulting volumes are not $\frac{1}{1}$, $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, etc., nor anything like it, except in the very lowest of the series. Still we are warranted in all cases in saying that the greater the pressure the greater the density for the same kind of matter.

Now, a few words on the formation of a solid crust over a molten sphere are entirely pertinent. It has been held by some authors that no crust can form over such a sphere; for, say they, *when the surface cools it is heavier than the molten mass within, and must necessarily sink; so that the centre would become solid first.* First, here is a palpable *reductio ad absurdam;* for this would necessarily result in cooling so as to solidify at the centre first. Can any rational mind accept this absurdity?

Second, ejected lavas always cool on the surface first, while yet the deeper portions are molten even so as to flow long after a solid crust has been formed. Thus does direct observation show the falsity of their hypothesis. No more need be said on that score.

Third, these authors neglect the fact that the lighter materials lie like a thick blanket around the outside of the sphere; and though they were to become frozen even, they could never sink into the molten heavier matter. Cold iron can not sink in molten gold. Cold silicon can not sink in molten iron. Yet, all the lighter materials are on and form the outside of earth, and of every other sphere where they exist. Unless there may exist a cosmic sphere of pure gold or pure platinum, or something of that kind, their hypothesis can never be realized.

Fourth, these lighter materials are highly non-conductive to heat, and hence husband the internal heat most providentially; so that earth will continue to have an internal heated core for raising mountains, continents, islands, etc., eons to come, as it thus far has had during eons past.

Fifth, the dream of those other philosophers, that all the waters of all the oceans will disappear to the centre of earth, cannot be realized, unless the outer non-conductive materials are in excess of the heavier central materials, which the higher mean gravity of earth seems to contradict.

Sixth, this fact of heavier central materials insures the molten condition of a portion of the centre, in spite of all contrary hypo-

theses. Through these heavier materials conduction is rapid, and the maximum is easily maintained. Mark! I say a portion of the centre, for the centre is unquestionably solid, as a resultant of pressure, the temperature being the maximum attained at the point of liquefaction. As the inner portion consists of the heavier materials, which are also far better conductors of heat, and rendered still better conductors under the immense pressure of the superincumbent materials, this solid nucleus will maintain, by conduction, this maximum temperature throughout. Finally, it may not be void of all interest to take a very brief view of earth's outer envelop.

The entire outer shell, as all know, consists mainly of two persistent gases—oxygen and nitrogen; oxygen, a constantly active, ever varying, yet constantly nearly the same in proportion; and nitrogen, a neutral dilutent for the active oxygen. With these two are mingled a few other substances, most conspicuous of which is watery vapor.

Next is a shell—a little broken—of water. This is followed, in the descending order, by a shell of mingled substances, the common rock materials. These are very poor conductors of heat. The lighter of these materials do not form a very thick mass. As the entire mass of earth, including all these, has a much higher specific gravity than any of these, it follows that heavier materials soon begin to take the place of these; nevertheless, this outer envelop must be sufficient to protect the heated nucleus, and volcanic emissions show that their seat is not below this outer shell, but in it. —*Ira Sayles, Ithaca, N. Y.*, March 12, 1888.

(To be continued.)

THE ATTACHMENT OF PLATYCERATA TO FOSSIL CRINOIDS has been long known, but the hitherto extreme rarity of illustrative specimens has necessarily occasioned only brief explanatory remarks. Inasmuch as the gasteropod shell was invariably situated on the crinoidal vault, and covering the ventral opening, which was erroneously regarded as the mouth of the crinoid, conclusive evidence of the carnivorous habits of the crinoideans was thought to be established. Other explanations were from time to time offered, but for the most part they were also fallacious, and originated in wrong conceptions relative to the true functions of certain structures peculiar to the group of echinoderms. Opportunity has recently been offered for the examination of an extensive series of palæocrinoids with attached Platycerata, embracing numerous specimens of the following species: *Ollacrinus tuberosus* Lyon and C., *O. typus* Hall, *Physetocrinus ventricosus* Hall, *Strotocrinus regalis* Hall, *Dorycrinus immaturus* Wachsmuth and Springer, *Marsupiocrinus cœlatus* Phil-

lips, *Eucladocrinus millebranchiatus* Wachs. and Sp., *Platycrinus hemisphæricus* M. and W., *Arthroacantha punctobrachiata* Williams, *Pterotocrinus acutus* Weth., *P. bifurcatus* Weth., *P. spatulatus* Weth., *Cromyocrinus simplex* Trauts., *Scaphiocrinus sp. und.* and *Actinocrinus verrucosus* Hall. It will be observed that in all the above species, with two exceptions, the vault is more or less depressed or nearly flat, with a simple anal opening, while in the last species mentioned the anal aperture is at the extremity of a prolonged anal tube—the so-called "proboscis"—but in this single instance the tube appeared to be injured, and probably has a second opening at the base. In every example, whether attached to the vault, as in the majority of the genera, or to the side of the calyx, as in Platycrinus, the molluscan shell is situated over the anal opening.

Summing up the predominant physiological and structural features suggested by recent investigations, it appears: (1) that the Platyceras was attached to the crinoid for a considerable length of time, and very probably for life, as is evidenced by the margin of the gastropod shell, corresponding exactly to the irregularities of the crinoidal surface—first suggested by Meek and Worthen; (2) that the anterior portion of the shell is always directly over the anal aperture of the crinoid, and that as growth in the shell continues the posterior margin is removed farther and farther from the vault opening, as is shown by the shallow concentric channels made by the margin of the shell in the vaults of Strotocrinus and Physetocrinus; (3) that the nourishment of the mollusc must have been derived chiefly from the excrementitious matter from the crinoid, though the gasteropod may have subsisted also on animalcules and microscopic plants, as in the case of the living representatives of the closely allied genus Capulus; (4) that the shape of the shell aperture and its marginal configuration were dependent entirely upon the surface of attachment, and hence are of small classificatory value; and (5) that the entire form of the shell was determined to a greater or lesser extent by the surface upon which the gasteropod was stationed.

The species of Platyceras in which the sedentary habits are positively known from the attachment of the gasteropod shells to crinoids are: *P. equilaterum* Hall, *P. infundibulum* M. and W., *P. parasiticus* Trauts., *P. erectum* Hall, *P. formosum* Keyes, *P. chesterense* M. and W., *P. dumosum* Conrad, and several undetermined species.—*Charles R. Keyes.*

Glyptocephalus not Identical with Bucklandium.—In the American Naturalist for May and September, 1888 (Vol. XXII., pp. 448, 828), I have used the name *Bucklandium* (Kœnig) as a substitute for *Glyptocephalus* of Agassiz (1843), the latter name

having been previously given to a well-marked existing genus of Pleuronectids by Gottsche (1835). I did this, as indicated in my communication (p. 828), solely on the authority of Pictet, who believed that the *Bucklandium* was the same as *Glyptocephalus* Agass.,[1] the work of Kœnig not being accessible to me at the time, and Prof. Pictet being recognized as a special authority on eocene fishes. But in the *Geological Magazine* for Oct., 1888 (p. 471), and also in *The Annals and Magazine of Nat. History* for Oct. (6 ser., v. II, p. 355), Mr. A. Smith Woodward, after an examination of the type of *Bucklandium diluvii*, "determined that it is truly the imperfect head and pectoral arch of a Siluroid." Incredible as such a malidentification on the part of Pictet must appear, I presume the determination of Mr. Woodward must be accepted, and, at any rate, that the name *Bucklandium* has nothing to do with *Glyptocephalus*. Consequently, a new name must be provided for *Glyptocephalus* Agass. *Glyptocara*, having the same meaning, may be employed. —*Theo Gill.*

Dr. C. A. White, of the United States Geological Survey, writes the senior editor as follows:—"I have just returned from Texas. I went to Baylor, Archer and Wichita counties, and found that Mr. Cummins was entirely correct in his reported discovery of Mesozoic and Palæozoic types of invertebrates commingled in one and the same layer of the Permian. I went with him to his localities, and collected with my own hands a good lot of the fossils. I shall support your published opinion—or rather determination—as to the Permian age of the formation."

The Nomenclature of the Mammalian Molar Cusps.—Every fresh discovery among the primitive mammals tends to confirm the theory that the evolution of the molar crowns has been, in a succession of stages, beginning with the single reptilian cone, the *homodont* type of Rütimeyer (*Haplodont* Cope). Comparative anatomy and the palæontological record combine to demonstrate this proposition for all orders of mammals excepting the Monotremes, Multituberculates and Edentates—the history of the teeth of the former classes is incomplete. Our knowledge of the edentates leaves it uncertain whether the molar crowns are in a primitive or degenerate condition; we know that they once possessed enamel, but the analogical degeneration of the molar crowns among the cetacea from a complex to a primitive type makes any conjecture as to the crowns of the primitive edentates very doubtful. Excluding the representatives of the Multituberculata, Cope has shown

[1] Je crois que c'est [*i.e.*, "*Glyptocephalus radiatus* Agass."] la même espèce que celle qu'il a figurée dans les *Icones sectiles*, pl. 8, sous le nom de Bucklandium. Voyez [Traité de Paléontologie par Pictet], t. I., p. 144, et t. II., p. 66 [et p. 123].

that the tritubercular stage, in one form or other, is universal among the known lower Eocence Mammalia. In a recent memoir, I showed that a large proportion of the Mammalia of the Mesozoic period, again excluding the Multituberculates, were in the line of *trituberculy*, and a renewed examination of the English types *removes every one of the apparent exceptions* to this law. Among the American Jurassic types there are still several apparent exceptions.

In view of the evidence for the almost universal presence of the tritubercular stage in the present or past history of the upper and lower molars, I have already advocated a distinct nomenclature for the different cusps which compose this molar and its derivatives, up to the stage of the acquisition of six tubercles in the upper molars and five in the lower. This is the final stage in which the tubercles reman distinct. The nomenclature now in general use is based, for the most part, upon the secondary or acquired position, and in no instance, so far as I know, upon the demonstrable homologies of the cusps in the upper and lower jaws. Compare for example, the molars of *Mioclænus* and *Hyopsodus*. By those familiar with Cope's writings upon this subject, it will be recognized at once that the antero-internal cusp of the lower molar of *Mioclænus* is not homologous with the antero-internal cusp of the upper molar of the same genus, nor is it homologous with the antero-internal cusp of the lower molar of *Hyopsodus*.

The nomenclature proposed is based upon the fact that the cusps composing the main triangles are homologous with each other and that some of the cusps superadded to these to form respectively the six and five tubercled molars, have probably originated in a similar manner. The terms for the three main cusps are selected to indicate, as far as possible, the primitive position and the order of evolution. The lower molar cusps are arbitrarily distinguished from those of the upper molars by the termination *id*.

Terms proposed.		*Terms now in use.*	
Up. Molars.	*Low. Molars.*	*Upper Molars.*	*Lower Molars.*
Protocone.	Protoconid.	Antero-internal cusp.	Antero external cusp.
Paracone.	Paraconid.	Antero-external "	Antero-internal " or 5th cusp.
Metacone.	Metaconid.	Postero-external "	Postero-internal " or intermediate "
Hypocone.	Hypoconid.	Postero-internal " or 6th cusp.	Postero-external "
Protoconule.		Anterior-interme diate cusp.	
Metaconule.		Posterior-intermediate.	
	Epiconid......	....	Postero-internal cusp.

This note is from an abstract of a paper presented to the British Association at Bath upon the Evolution of the Mammalian Molar

teeth. The full paper will appear in the next number of the NATURALIST. In the meantime I will be glad to receive suggestions or criticisms upon the above terms.—*Henry F. Osborn.*

MINERALOGY AND PETROGRAPHY.[1]

PETROGRAPHICAL NEWS.—The basaltic rocks of Alsace, according to Linck,[2] embrace feldspathic and non-feldspathic varieties. Of the latter a limburgite from Reichenweiler contains a glassy base, which deports itself towards reagents like nepheline, a fact which would cause the rock strictly to be classed among the nepheline basalts. Its olivine yields upon analysis:—

SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	Na_2O
41.53	2.33	0.58	10.27	43.60	1.69,

indicating a replacement of part of the magnesium of the typical molecule by aluminium and sodium. Olivine concretions occurring in this rock consist of olivine, bronzite and a bottle-green augite containing 2.64 per cent. of K_2O and 2.41 per cent. of Na_2O.—Brief notes on the rocks of Fernando Noronha, an island in the Atlantic about two hundred miles north-east of Cape St. Roque, Brazil, are communicated from the laboratory of the Johns Hopkins University by Mr. Gill.[3] The rocks described are phonolites, from conical hills similar to those in the Hegau in Baden, nepheline-basanites and basalts, nephelinite, and finally basalt glass. An extended petrographical study of these in all their different varieties will be published later.—Although the rocks of the Bohemian Mittelgebirge have been made the subjects of study by several petrographers, Hibsch[4] finds something new to say of them in a late article in *Tschermak's Mittheilungen.* The trachytes of the region are younger than the phonolites or the basalts and occur in but a few localities. Their porphyritic sanidines possess a rounded outline and are fringed with a rim of newly formed secondary feldspathic substance. Many of the phonolites contain a large amount of plagioclase, and have besides a trachytic habit. In their cavities is often noticed quite an interesting development of secondary albite. Little crystals of this mineral extend out from the sides of the cavity and penetrate into a mass of analcite, which, together

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.
[2] Mitth. d. Comm. f. d. Geol. Landesunters, von Elo.-Lothr., 1887, i., p. 49.
[3] Johns Hopkins Univ. Circulars, No. 65, April, 1888, p. 71.
[4] Min. u. Petrog. Mitth., 1887, p. 232.

with chabasite, has resulted from the alteration of the plagioclase. —In Blum's "Pseudomorphosen"[1] mention is made of a granite at Vordorf in the Fichtelgebirge, in which the flesh-red orthoclase is partially altered into epidote. Sandberger,[2] who has found blocks of the same rock, states that the epidote is more likely an alteration product of hornblende or augite, as it is associated with asbestus, while the red orthoclase is still fresh.—A grammatite rock occurs,[3] interstratified with phyllite, in the Bohemian Fichtelgebirge, between Klein-Wenden and Sichersreuth.—The third paper on the rocks of the Cortlandt Series, in the Hudson river, embraces[4] the treatment of the gabbros and diorites associated with the peridotites and norites which have been described in another place.[5] The gabbros present no peculiar features other than the granulation of some of their constituents. Two types of diorite are distinguished. One, containing brown hornblende, tends to pass into gabbro, norite, or hornblendite. The other, containing green hornlende, is closely related to mica-bearing rocks. The mica-diorites (Dana's soda-granites) are essentially coarse-grained aggregates of plagioclase and biotite, with often a little orthoclase and quartz, and sometimes garnet as a metamorphic mineral. The plagioclase has a specific gravity between 2.67 and 2.65, and is sometimes twinned, while at other times it is entirely free from twinning lamellæ. The most noticeable feature in the rock is the occurrence in it of a pale green non-pleochroic epidote, which appears to be original. The mineral is generally without terminations. It is strongly corroded on its edges as if eaten into by a liquid magma. The paper closes with a graphic representation of the close relations, which the author, Dr. Williams, has found to exist between the various eruptive members of this series.

Mineralogical News.—In Douglas Co., Oregon, is a bed of *nickel silicate*, resembling garnierite, whose origin has been determined with some degree of certainty by Prof. Clarke.[6] A pure specimen of the mineral was found to have the composition:—

TiO	MgO	SiO_2	$Al_2O_3+Fe_2O_3$	Loss on ign.	Loss at 110°
27.57	10.56	44.73	1.18	6.99	8.87

The country rock associated with this mineral is a peridotite whose olivine contains .26 per cent. of nickel oxide. This rock was examined by Mr. Dieles, and was found to be penetrated by cracks filled with serpentine and quartz. The nickel mineral, wherever it

[1] iii., p. 120.
[2] Neues. Jahrb. f. Min., etc., 1888, i., p. 208.
[3] Sandberger: Neues Jahrb. f. Min., etc., 1888, ii., p. 202.
[4] Amer. Jour. Sci., June, 1888, xxxv., p. 438.
[5] Amer. Naturalist, June, 1887, p. 568.
[6] Amer. Jour. Sci., xxxv., 1888, p. 483.

occurs, is always associated with these alteration products. It occurs in the serpentine, which is directly connected with the grains of olivine from which it has been derived. There is every reason to believe that the nickel silicate came from the same source. A study of the Webster Co., N. C., and the New Caledonia nickel deposits indicate the same origin for the ores at these places.—A feldspar from Kilima-njaro, similar to that from the rhombic porphyry of Christiania, has been analyzed by Fletcher.[1] Its composition is:—

SiO_2	Al_2O_3	CaO	Na_2O	K_2O
62.17	23.52	2.90	6.80	4.61,

corresponding to a mixture of the anorthite, microcline and albite molecules in the proportions An, $Or_{\cdot 94}$, $Al_{2\cdot 11}$. The extinction on the clinopinacoid is about 4° 20′. On the basal plane it is parallel to the clinopinacoid cleavage. In sections cut parallel to the orthopinacoid the microcline structure is visible.—Sandberger[2] calls attention to the properties of the carbonaceous material in the crystalline limestone of Wunsiedel in the Fichtelgebirge, as those of an amorphous substance corresponding to the graphitoid of Inostranzeff[3] and Sauer.[4] The hardness of the mineral is 3 and the specific gravity 2.207. It yields when burned 1.78 per cent. of ash.—A new analysis of *spodumene* from Brazil leads Jannasch[5] to the results reached by other analysts, and affirms the correctness of the formula $(Li.\ Na)_2\ Al_2\ (SiO_3)_4$.—Brief notes on the six iron sulphates, *coquimbite, copiapite, quenstedtite, bückingite, stypticite* and *halotrichite,* from Chili, are communicated by Linck[6] in a letter to the *Neues Jahrbuch.*

Morphological and Physical Mineralogy.—Since almost all of our knowledge of the morphological properties of *markasite* depend principally upon the measurements of Hausmann and Sadebeck, and since these mineralogists disagree in their results, Gehmacher[7] has thought it worth while to measure the crystals in his possession, and from these measurements to recalculate the planes occurring in them. He finds the axial ratio to be: .7623 : 1 : 1.2167. The formulas of the different planes are determined, and other observations are made which indicate a monoclinic symmetry for the mineral.—Zepharovich's[8] measurements of *trona* crystals from Lake Lagunillas, Venezuela, show their axial relation to be:

[1] Min. Magazine, July, 1887, and Zeits. f. Kryst. xiii., '87, p. 384.
[2] Neues Jahrb. f. Min., etc., 1888, i., p. 200.
[3] Neues Jahrb. f. Miner., etc., 1880, i., p. 97.
[4] Zeits. d. d. Geol. Zeits., xxxvii., p. 441.
[5] Neues Jahrb. f. Min., etc., 1888, i., p. 196.
[6] Neues Jahrb., f. Min., etc., 1888, i., p. 213.
[7] Zeits. f. Kryst., xiii., 1887, p. 242.
[8] Ib., xiii., 1887, p. 135.

2.8459 : 1 : 2.9696. $\beta = 77° 23'$. Their composition corresponds to that of the same mineral from other localities.—Very pure *idrialite* ($C_{80}H_{36}O_2$), crystals from Idria in Krain, consist of small plates bounded on two sides by parallel planes. The extinction against one of these sides is 5° 33′, and the optical angle of the mineral, measured in oil, is $2H = 101° 20'$. The interference figure is that of a biaxial crystal, with the bisectrix perpendicular to the surfaces of the plate.—A great many observations have been made by Niedmann[1] upon *barite* in order to determine the relations between the elasticity and the other physical properties of the mineral. He finds the direction of greatest elasticity to be perpendicular to the plane of easiest cleavage. The shape of the curve representing the relative values of the coefficients of elasticity for any given plane, corresponds in all cases to the symmetry of the orthorhombic system.

MISCELLANEOUS.—In a late paper Dr. Cohen[2] discusses critically the arguments in favor of the chemical theory of deposition for gold in placers, and also those in favor of its mechanical origin. He gives the main facts bearing on the subject, and shows that some of those which have always been cited as favoring the chemical theory, are of doubtful existence. It has been stated, for instance, that placer gold always contains less silver than vein gold from the same region. Analyses of specimens from Buttons Creek, in the South African gold-fields, however, prove that this is not always the case. Dr. Cohen's results are:—

	Au	Ag	Cu	Insol.
Vein gold	94.48	5.16	.25	.02
Placer gold	91.38	6.49	.09	.78
	95.02	4.60	.11	.07

He thinks that whereas placer gold, for the most part, is derived by the breaking down of gold veins, there is occasionally in addition a deposition of the metal from its solutions. This, however, he regards as playing but a subordinate rôle in the formation of placer gold.—A meteoric stone,[3] found in the San Emigdio mountains in California, is composed of chondri of olivine and anstatite, imbedded in a base composed of the same minerals in a fragmental condition. Nickeliferous iron constitutes 6·21 per cent. of the stone. It occurs in lumps and masses, often surrounding the chondri. An analysis of the metallic portion yielded 11.27 per cent. of nickel.

[1] Ib., xiii., 1887, p. 362.
[2] Mitth. d. naturw. Ver. f. Neuvorpom. u. Rügen, 19 Jahrg., 1887.
[3] Merrill: Am. Jour. Sci., June, 1888, p. 490.

ZOOLOGY.

CELL-DIVISION.—The following abstract of recent researches on cell-division is taken from the *Journal of the Royal Microscopical Society.*—Herr T. Boveri believes that the course of karyokinetic division may be generally described in the following terms:—The chromatic nuclear material becomes collected together with a definite number of isolated pieces of a form characteristic of the kind of cell—the chromatic elements; an achromatic filamentar figure is formed in the two poles, either from the substance of the nucleus or from that of the cell. The chromatic elements, so far as their number, form and size allow it, are deposited in the equatorial plane of the achromatic figure; the chromatic elements divide into two halves, one of which makes its way toward either pole; the daughter elements break up in the framework of the new nuclei.

In the ova of *Ascaris lumbricoides* the germinal vesicle has, in the earliest stage, the typical structure of the resting nucleus, and we are justified in supposing that the chromatic elements arise from the framework in exactly the same way as in the other cases, though the details cannot certainly be made out in consequence of the small size of the object. The arrangement of the elements in an equatorial plate, their transverse division, and the formation of daughter-plates, are effected in just the same way as they are now known to be in other cases, and especially in the ova of arthropods. The only point of difference is the relation of the daughter-elements, which remain in the egg after the expulsion of the first polar globule, for these remain isolated, and are so the direct mother-elements of the next spindle.

In the germinal vesicle of the ovum of *Ascaris megalocephala* (Carnoy's type), two independent portions of chromatin are found in the earliest known stage. Though nothing is certainly known of their mode of formation, it may be assumed that they are derived from a typical nuclear framework. This conversion, however, of the reticulum into the chromatic elements, which in other cells and in some ova (*A. lumbricoides*) directly precedes division, appears, in most eggs, to take a long time. The important difference in the eggs of the type of Van Beneden is that there is but one chromatic element; this seems to be unique.

There are many reasons for supposing that the division of the chromatic elements sometimes happens at a time when there is no indication of the achromatic figures of division. The most striking of these cases has been lately described by Flemming. Similar phenomena have been observed by the author in the eggs of Ascaris. In the germinal vesicle of *Ascaris lumbricoides* the

twenty-four rods exhibit the most distinct transverse division long before the germinal vesicle begins to be converted into the spindle.

After considering several cases in different forms the author expresses his belief that they form parts of a series in the degeneration of the process of nuclear and cellular division. In the case of *Corydalis cava*, described by Strasburger, the process is least rudimentary; two typical daughter-nuclei arise, but these again fuse into a single nucleus; in Thysanozoon and *A. megalocephala* daughter-stars or plates are formed, but at once pass into a resting nucleus. In the cells of Flemming and Carnoy there is a division of the chromatic elements, but no arrangement in two groups.

Herr Boveri suggests that in the parthenogenetic eggs described by Weismann as having only one polar globule, we have to do with the same process as in the eggs of Ascarids; there are two divisions, but the second is limited to division of the chromatic elements. If this be so, the parthenogenetic development is not to be regarded as dependent on the suppression of the development of the second polar globule, but by its retention in the egg and the fusion of its nucleus with the ovarian nucleus. The second polar globule may thus be regarded as playing the part of the spermatozoon, and it may be said that parthenogenesis is due to fertilization by the second polar globule.

In the achromatic nuclear figure the mode of origin of the spindle, and the complete want of polar rays are of significance. The often discussed question whether the nuclear spindle is derived from the substance of the nucleus, or of the cell, may, in the case of Carnoy's type of *Ascaris megalocephala*, be certainly decided in favor of the former.

Nervous System of the Starfish.—Dr. Carl F. Jickeli recognizes (*Zool. Anzeiger*, 1888, p. 339) four elements in the nervous system of the starfishes:—(1) The ambulacral nervous system; (2) the sub-epithelial plexus of the surface of the body, described by Romanes and Ewart; (3) the paired thickenings of the walls of the perihæmal system described by Lange; and (4) a visceral system. The sub-epithelial plexus is connected with the ambulacral system. Lange's nerves consist of three layers; (*a*) a delicate flattened epithelium lining the perihæmal space; (*b*) large ganglion cells, the processes of which form nerve fibres; and (*c*) a connective-tissue layer which forms a partition between Lange's and the ambulacral nerves. Jickeli's visceral system consists of a layer of fine fibres containing stellate cells at the base of the epithelium of the digestive tract. This system is best developed in the anal region of *Astropecten andromeda*.

STIZOSTEDIUM IN THE BASIN OF THE CONNECTICUT.—I had the pleasure of announcing in the AMERICAN NATURALIST for October, 1887, the discovery of a specimen of *Stizostedium vitreum* at Cromwell, Conn., in a tributary of the Connecticut River. This is, so far as I am aware, the only recorded instance of the occurrence of the species in any of the rivers of the Atlantic coast between the St. Lawrence and the Susquehanna. It may be worth while to mention that in August, 1888, another specimen of the same species was taken very near the same locality. The second specimen, like the first, is a small one, each of them measuring about twelve inches in length. Both specimens are preserved in the Museum of Wesleyan University.—*William North Rice, Wesleyan University, Middletown, Conn.*

DESCRIPTION OF A NEW SPECIES OF MEADOW MOUSE FROM THE BLACK HILLS OF DAKOTA.—In the higher parts of the Black Hills there lives a species of Arvicola resembling our eastern Meadow Mouse (*A. riparius*) in size and côloration, but differing from it strikingly in the possession of a very long tail and very large ears. Two specimens were collected in some brush land bordering a creek in the vicinity of Custer, Dakota, by Mr. Vernon Bailey, in July last. Examination of their teeth shows them to belong to the subgenus Myonomes. The species has no nearer relative than *Arvicola townsendi*, from which it differs in relative proportions and in other particulars. It may be known by the following diagnosis:

ARVICOLA (MYONOMES) LONGICAUDUS sp. nov.

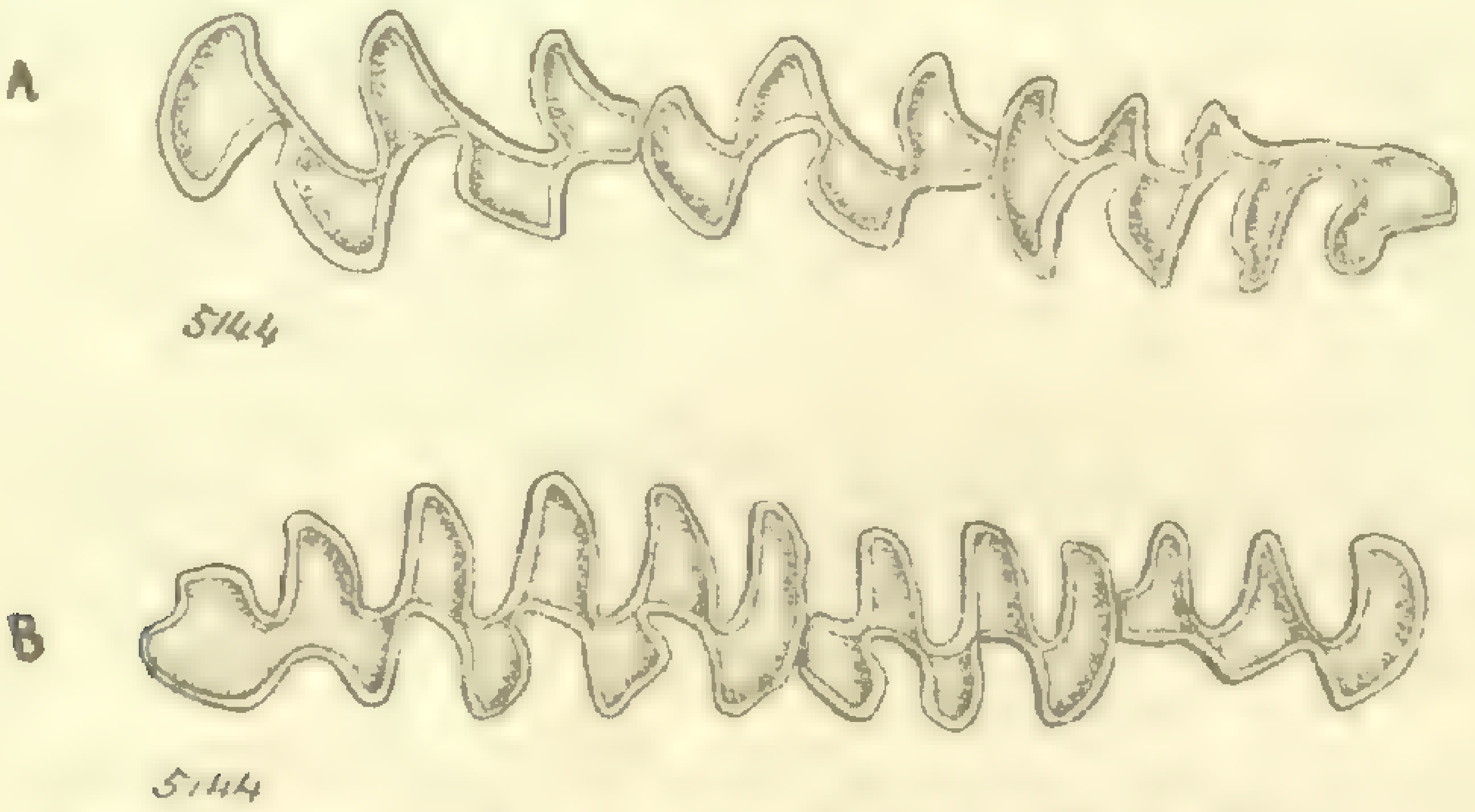
Long-tailed Arvicola.

Type No. $\frac{4509}{5144}$, fem. ad., Merriam Collection. From Custer (in the Black Hills), Dakota, July 19, 1887. Vernon Bailey.

Description of type.—Size about that of *A. riparius*. Ears very large, suborbicular, with a large antitragus capable of completely closing the meatus; tail very long, relatively longer than that of any heretofore described species of the genus; color much as in *A. riparius;* sides and upper parts bister, more or less grizzled, with a faint tinge of rusty along the middle of the back; under parts whitish, the plumbeus basal portion of the fur showing through. There is no sharp line of demarcation between the color of the belly and that of the sides; the tail is slightly paler below than above, but lacks a distinct line of demarcation.

Measurements (taken in the flesh): total length, 185 mm.; tail, 65 mm.; hind foot, 21 mm. Ear (measured from the dry skin):

height from anterior base, 14 mm.; from crown, 8 mm.; breadth, 13 mm. Another specimen, also a female, taken at the same locality, July 13, 1888, agrees with the foregoing in size and coloration. It measured in the flesh: length, 184 mm.; tail, 61 mm.: hind foot, 22 mm.



Molar teeth of Arvicola longicaudus ♀
A. Left upper series B. Left lower series.

Dental characters.—A glance at the accompanying drawing of the crowns of the molar teeth shows that *Arvicola longicaudus* has the back upper molar of Myonomes. The middle upper molar, however, lacks any trace of the postero-internal loop or spur supposed to be characteristic of this subgenus, and the lower teeth present several peculiarities not mentioned in any description or drawing heretofore published.—*Dr. C. Hart Merriam.*

Zoological News.—General.—The zoological papers in the *Journal of the Elisha Mitchell Scientific Society* for 1888 are: "A List of Fishes in the Museum of the University of North Carolina," by V. S. Bryant; "List of the Butterflies collected at Chapel Hill, N. C.," by A. Braswell; "Aquatic Respiration in the Muskrat," by W. L. Spoon; "New Instances of Protective Resemblance in Spiders," and "Notes on the Tube-inhabiting Spider, *Lycosa fatifera*," by G. F. Atkinson.

Protozoa.—The genus Gromia is usually regarded as an inhabitant of moist earth, but Dr. H. Blanc describes a species which he considers as a member of the genus from the ooze at the bottom of Lake Geneva. His paper, which occurs in the *Recueil Zool. Suisse* (Vol. IV.), is illustrated by a plate.

Worms.—Dr. Edward Tuckerman records (*Zool. Anzeiger*, No. 287) a second specimen of *Tænia saginata*, which was larger than the former specimen (Am. Nat., p. 360, 1888), measuring 8.253 metres. This latter specimen presents several interesting anomalies of structure. In the same number Dr. Ed-

ouard Brandt records two instances of *Tænia cucumerina* in the human body.

Dr. A. C. Stokes describes two new North American Oligochæte worms (*The Microscope,* viii., 1888), *Ælosoma distichum* and *Pristina flavifrons,* and Gustav Eisen characterizes a new genus of the same group (*Mem. Cal. Acad.,* ii., 1888) under the name *Sutroa rostrata.*

Criodrilus lacuum is made the subject of an extensive anatomical monograph by A. Collier in the *Zeitsch Wiss. Zoologie,* Bd. xlvi., 1888.

Molluscs.—The crystalline style is a peculiar structure found in a pocket developed from the stomach of certain lamellibranch molluscs. Many theories have been advanced as to its nature and physiological functions. Möbius maintained that it was a reserve food supply, and recently (*Biol. Centralblatt,* 1888) Haseloff has experimented on *Mytilus edulis,* in which the structure is almost constantly present. He starved some individuals for a few days, and found that the style had disappeared. Others of the same starved lot were afterward fed with abundant food, and on examination were found to possess the style. Haseloff regards the style as a chemical modification of surplus food rather than a secretion.

Malacopoda—Peripatus comes in for several papers recently. Adam Sedgwick concludes his account of the development of the Cape species of the genus in the *Quarterly Journal of Microscopical Science,* Vol. XXVIII., part 3, and in part 4 of the same volume monographs the thirteen or fourteen known species of the genus. W. L. Sclater describes the early development of a South American species of the genus in part 3, and Miss Lilian Sheldon describes points in the anatomy of *P. capensis* and *P. novæ-zelandiæ* in part 4 of the same volume. In Vol. XII. of the *Zoologist,* S. A. Olliff has notes on Periaptus in New South Wales, and F. Jeffrey Bell calls attention to the fact that years ago Schmarda described a species of the genus (*P. quitensis*) from South America.

Crustacea.—Bouvier treats of the circulatory apparatus of the Decapod crabs in the *Bulletin de la Societé Philomathique de Paris,* Vol. XII. His observations were made on the genera Maia, Stenorhynclus, Pagurus, Astacus, Palinurus, Portunus, etc.

Hoek describes a new parasitic Cirripede (*Sylon challengeri*) in Spencer Bates' report on the Macrura of the Challenger.

Cephalochorda.—Dr. E. Rhode (*Zool. Anzeiger,* XI.) describes the histology of the nervous system of Amphioxus. He finds it to resemble closely that of the Chætopod Sthenelais, in the presence of

colossal nerve fibres given off from regularly arranged giant ganglion cells. In both the supporting tissue is of ectodermal origin.

FISHES.—Messrs. Jenkins and Everman discovered a new species of the genus Chologaster this summer in the outlet to Lake Drummond, in the dismal swamp of Virginia. The discovery is especially interesting, as the genus is presumably the representative of the ancestors of the blind-fishes, Amblyopsis and Typhlichthys. Only their species of the genus — *C. cornutus*, *C. papilliferus* and *C. agassizii* were known before, and these were represented by but few specimens. Jenkins and Evermann were fortunate in obtaining a considerable amount of material of the new species.

MAMMALS.—Dr. Frederick Tuckerman describes the histological structure of the taste-organs of the bat, *Vespertilio subulatus*, in Vol. II. of the *Journal of Morphology*.

Some years ago the greenish color of certain of the sloths was attributed to the presence of an algæ upon the hair. Recently Madam Weber von Bosse has described two genera and three species of these parasitic algæ. The new genus Trichophilus is green, the other, Cyanoderma, with its two species is violet. From 150,000 to 200,000 individuals of these algæ may occur on a single hair.

ENTOMOLOGY.[1]

SCUDDER'S BUTTERFLIES OF NEW ENGLAND.[2]—The long-looked-for work by Mr. Scudder, on the butterflies of New England, is about to appear. We are in receipt of a prospectus which includes sample pages and plates. Judging from this the work will surpass in fulness of detail and magnificence of illustration anything of the kind yet published ; and the scope of the work is an unusually broad one, including accounts of the structure of these insects in all stages of life, their variation, habits, manners, life-history, and their enemies ; also frequent discussions of problems suggested by their study.

[1] This department is edited by Professor J. H. Comstock, Cornell University, Ithaca, N. Y., to whom communications, books for notice, etc., should be sent.

[2] The butterflies of the Eastern United States and Canada with special reference to New England, by Samuel Hubbard Scudder, Cambridge ; published by the author, 1888. Twelve monthly parts, $5.00 per part, or $50.00 for the whole work if paid for before Jan. 1, 1889.

This work was at first intended to embrace only the butterflies known to occur in New England or its immediate confines; but it has been extended so as to include in its descriptions and histories some account of all the butterflies of North America, east of the Mississippi, excepting such as are found only in the unsettled parts of Canada, or south of Kentucky and Virginia.

Not only every species, but also every genus, tribe, sub-family, and family, are described and discussed with a fulness never before attempted, except in individual cases. The descriptions include in each instance not merely the perfect form, but when possible, the eggs, the caterpillar at birth and in the succeeding stages, and the chrysalis, together with the distribution, life-history, habits, and environments of the insects. A great accumulation of new facts and observations are embodied. Analytical tables applicable to every stage are used wherever possible.

Over seventy distinct excursuses, distributed throughout the work, discuss separately all the interesting problems which arise in the study of butterflies (whether of distribution, structure, history, or relation to the outer world), in themselves forming a complete treatise on the life of these insects. Judging by the fragment of the excursus devoted to dimorphism and polymorphism which is given in the prospectus, this part of the work will be of the highest interest to those who study entomology in a scholarly way, whatever their specialty.

Every page of this treatise bears evidence of the wonderful amount of pains-taking labor devoted to its preparation. For twenty years the author has been at work upon it; and for the last eight years it has received his undivided attention. No one else has brought to the study of this group of insects more scholarly attainments, nor has achieved such magnificient results. We trust that the work will receive the recognition that it deserves.

Vision of Caterpillars and Adult Insects.—Prof. F. Plateau continues his researches on the powers of vision by an investigation of caterpillars and of the frontal ocelli of adult insects.[1]

(1) He made a series of experiments and observations on the caterpillars of fifteen species of Lepidoptera, and obtained the following results: (a) The eyes of caterpillars have a more important rôle than that of simply distinguishing between light and darkness. They really see, though badly. (b) The distance of distinct vision is short, and usually about a centimetre. (c) At greater distances caterpillars can perceive large masses, but do not discern their nature. (d) They only perceive the movements of bodies within the limits of distinct vision. (e) Tactile hairs present on the anterior segments of many forms are of much sensory importance.

[1] Bull. Acad. R. Sci. Belg. xv. (1888), pp. 28–91.

(f) The antennæ are much used in testing the path and surrounding objects.

(2) In the next chapter Prof. Plateau discusses the function of the frontal ocelli of adult insects. He gives an historical summary of past researches, describes the manifold conditions of his own observations and experiments, submits tabulated results of his investigations of different forms, and formulates the following conclusions: (a) Diurnal winged insects, Hymenoptera, Diptera and Lepidoptera, when blinded by covering the entire eyes with black or by cutting all of the optic nerves, rise to a great height in the air when liberated. (b) When the compound eyes are suppressed, but the frontal ocelli left, in Hymenoptera, Odonata, and Diptera, the insects behave exactly as if the ocelli also had been suppressed. When freed, they rise vertically as before. In a chamber lighted from one side they behave as if they were totally blind. (c) But if the frontal ocelli be alone suppressed, the above insects behave as if they had lost nothing. (d) In diurnal insects equipped with compound eyes the ocelli count for almost nothing. They only afford the animals very feeble perceptions which they do not know how to use.

The author concludes his memoir with the following suggestions, which he describes as "plausible hypotheses," supported by a certain number of observed facts: (1) Diurnal insects, in which all of the eyes have been suppressed, still enjoy dermotoptic perceptions. (2) They are almost reduced to the same limitations if the ocelli are left at their disposal. (3) The dermotoptic perceptions are the primary cause of the ascending flight of liberated blinded insects. (4) The frontal ocelli serve neither for the perception of movements in adjacent objects, nor for the perception of light in relative obscure media. (5) The simple eyes, which the author has shown to function in an imperfect fashion in most Myriapods, in many Arachnids, and caterpillars, have entirely lost their utility in the great majority of insects equipped with compound eyes. (*Jour. Roy. Micr. Soc., June*, 1888.)

Life of Townend Glover.—A biographical sketch and an account of the writings of the late Towend Glover, the first United States Entomologist, written by Mr. Charles R. Dodge, has just been published by the Department of Agriculture at Washington.[1] Mr. Dodge was for a long time the assistant of Mr. Glover, and was one of his most intimate friends during the closing year of his life. He is, therefore, well fitted to perform this office and has done it in a very satisfactory manner. The work is illustrated by a portrait of Mr. Glover, copies of two of his earlier plates, and by several of his humorous caricatures. Numerous anecdotes are given

[1] U. S. Dep. of Agri., Div. of Ent., Bull. No. 18.

illustrating the peculiarities and eccentricities of this remarkable man. Following the biographical sketch is a chapter giving the history of Glover's great work entitled Illustrations of North American Entomology. There is also a short chapter on the Glover Museum, and a list of Mr. Glover's entomological writings; this includes sixty-four titles.

MONOGRAPHS OF NORTH AMERICAN SPIDERS.—We have received during the past month two monographs of North American Spiders. The larger of the two is of the family attidæ and is by George W. and Elizabeth G. Peckham. It is reprinted from the *Transactions of the Wisconsin Academy of Sciences, Art and Letters,* Vol. VII. It comprises 104 pages and is illustrated by six plates. An analytical key to the genera is given, and the specific descriptions are evidently very carefully prepared.

The smaller monograph is of the family Ciniflonidæ and is by J. H. Emerton. It is reprinted from the *Transactions of the Connecticut Academy,* Vol. VII. It comprises sixteen pages and is illustrated by three beautiful plates.

THE BEE-KEEPERS' GUIDE.—A new edition of this excellent manual of the apiary by Prof. A. J. Cook has just appeared. The work has been wholly re-written and revised, 150 pages and more than thirty illustrations being added. The greatest additions are in the chapters pertaining to the natural history of the honey-bee. We are glad to note also an improvement in the paper and press work. This is undoubtedly our best manual on the subject and it should be in the hands of every American bee-keeper.

ON PLATYPSYLLUS.—There appeared in the *Scientific American* Supplement of June 2, 1888, an important paper by Prof. Riley on the scientific relations of *Platypsyllus* as determined by the larva. The paper is based upon the study of larvæ collected for Prof. Riley by Mr. Lawrence Brunner in Nebraska. Three figures of the larvæ are given, and one of the adult. The conclusion drawn by the author is that this insect pertains to the order Coleoptera.

BIBLIOGRAPHY OF NORTH AMERICAN INSECTS.—Bulletin No. 19, of the Division of Entomology of the United States Department of Agriculture, is entitled An Enumeration of the published Synopses, Catalogues, and Lists of North American Insects. This is a very useful pamphlet, the scope of which is indicated by the title.

EMBRYOLOGY.[1]

On the Primary Segmentation of the Germ-bands of Insects.[2]—Prof. Veit Graber summarizes his important results on the embryology of insects as follows:—

1. The germ-band of insects is at first either discoidal (*Stenobothrus*, *Œcanthus*), or is oblong (*Hydrophilus*, *Lina*, etc.). The primitive discoidal germinal area corresponds principally to the (Urkopf) antennal segment, since the (Urrumpf) primitive body has at first very limited dimensions.

2. In most insects with an elongate germ-band, the primitive head-segment is also the first to be separated. An exception to this is found in *Lina*—if *Hydrophilus* is not taken into account—in which two transverse furrows appear simultaneously, forming three principal segments, which appear to correspond to the principal subdivisions of the insect body (head, thorax and abdomen).

3. The primitive body (Urrumpf) of the germ-bands of *Stenobothrus* and *Œcanthus* does not segment, as it has been assumed in the case in all insects hitherto, but before the permanent segments (metameres or microsomites) are established, the latter definitive segmentation is preceded by a subdivision into two and then three large segments (macrosomites).

4. Of these three primary segments (macrosomites) of the primitive body, the first corresponds to the sum of the jaw-bearing (gnathophorous) metameres—gnathal macrosomites—the second, the sum of the limb-bearing metameres—thoracic macrosomites—and finally the third to the abdomen—abdominal macrosomites.

5. In the process of the primary or macrosomitic segmentation of the primitive body there is no external segmentation, that is, transverse subdivision of the ectodermal plate, but a total segmentation of the inner (lower) layer, the hypo- (or ento-) blast.

6. The secondary or microsomitic segmentation of the primitve body (segmentation of the microsomites into metameres) does not proceed in *Stenobothrus* and *Lina* (and also in spiders according to Morin), as is generally assumed, from before backwards, but it first involves the middle or thoracic (Ursegment) macrosomite.

We may finally inquire as to the morphological significance of the primary subdivision into four or tetramerism of the germ-bands of *Stenobothrus* and *Œcanthus*.

[1] Edited by Prof. John A. Ryder, Univ. of Penna., Philadelphia.

[2] Über die primäre Segmentirung des Keimstreifs der Insekten. Morph. Jahrb. xiv. Hft. ii. 1888. Pp. 345–368, pls. xiv.–xv. Von V. Graber.

Since the two last primary segments (Ursegmente), namely, the thoracic and abdominal, correspond to the two sections of the body of the perfect insect, we may regard the primary segmentation as an anticipation of the later or tertiary segmentation. Against such a view two important facts are opposed. First, it is not to be forgotten that the primary segmentation does not conform to the tretiary, in that the head in the former does not constitute a primitive segment, but is divided into two sharply distinguished and heterogeneous sections, the primitive head segment (Urkopf) and the gnathophorous macrosomite.

Secondly, against the hypothesis alluded to, the whole progress of segmentation is opposed. If the macrosomites of the primitive body were to persist, as such, together with their later subdivisions (microsomites), as stem-unities of a higher order, the above view would be to some extent justified. The relation is, however, altogether a different one, in that between the few and unequally segmented stage on the one hand, and the similarly segmented end-stage on the other, a many and unequally segmented middle stage is intercalated, which bears scarcely a recognizable trace of the earlier segmentation, and out of which the trimerism of the end-stage is developed anew by the fusion of certain groups of metameres.

If the tetramerism of the segmented primary stage may not be readily explained by the not very sharply expressed trimerism of the end-stage, its cause must, without doubt, be sought in certain definite conditions of segmentation of the ancestors of insects. But, as I would especially point out, may the tetramerous germ-band stage here under consideration be compared with other adult similarly segmented arthropods without taking other matters into account, since, independently of the fact that our germ-band is not an independent (completed) living organism, there is wanting all support to a legitimate comparison of its macrosomites with other arthropods with few segments, such as the Nauplius, for example.

ARCHÆOLOGY AND ANTHROPOLOGY.[1]

(Continued from page 856.)

Dr. Brinton presented a human vertebra from Tampa Bay, Florida, found in the bog deposits of the quarternary geologic period. Its peculiarity was that the bony structure had passed and been replaced by a deposit of iron called limonite, so that it was an iron instead of a bone vertebra.

[1] This department is edited by Thomas Wilson, Esq., Smithsonian Institution, Washington, D. C.

Mr. Wilson said that the National Museum possessed the lower half of a human skull from the same neighborhood which had been treated in the same way. It was found associated more or less intimately with fragments of fossilized bones and teeth of the mastodon.

Prof. E. S. Morse, of Salem, Mass., read a paper, which he illustrated to the audience with a bow and arrow; showing a new system, the third in his series, of "Arrow Release."

Rev. W. M. Beauchamp displayed some Indian relics from central New York.

Prof. Joseph Jastrow, of the University of Wisconsin, read a most interesting paper on the "Psychology of Deceptions." He described deceptions practised upon the senses and said the foundation of legerdemain was to distract the attention by an unimportant operation from the critical moment wherein the vital change is made. He entered the domain of spiritualism but dealt with only that portion which was an evident deception, and had been exposed. The first general principle in these deceptions is that the medium performs to spectators in doubt as to the interpretation to be placed upon the scene which they witness, and are more or less ready to ascribe it to the supernatural. This mental attitude of the spectators is worth more to the medium than any factor in the performance. The difference between a spectator in this state of mind and one convinced of the fraudulent character of the manifestations and seeking to discover how the fraud is committed is very great. When the medium recognizes this condition of mind in the spectator the sitting will always be a blank. If the investigator is once convinced that he has evidence of the supernatural he soon sees it in every accident and incident of the performance; not only does he overlook natural physical explanations but the supernatural idea soon leads him to create marvels with sincerity. Thus, the believer, seeing a carelessly arranged drapery by a dim light thinks he recognizes in it the spirit of a dear friend or a well-known acquaintance. The same object is frequently recognized by different members of the circle as entirely different and wholly dissimilar persons. Little by little, through the neglect of observation, caution is abandoned, credulity takes possession of the spectator, and he is able to see impossibilities. Finally a fantastic explanation is considered more probable, the bounds of the normal are passed, and the believer having eyes sees not, and ears hears not, even the realities which happen before his face. If this seems impossible, turn back to the history of witchcraft.

In the afternoon the section met to hear Prof. Otis T. Mason, of the National Museum, Washington, D. C., deliver his lecture on "Women's Share in Primitive Industry." It was illustrated by photographs projected upon the screen by the lantern, of woman in

her different spheres of industry through savagery, barbarism, civilization, and into the heavens where she is deified and appears as a goddess.

Thomas Wilson, Esq., of the Smithsonian Institution, gave the result of his investigations as to the geographic distribution in the United States of man during the paleolithic period. An abstract of his remarks will appear at some future time in the NATURALIST.

It was now after three o'clock in the afternoon of the last day of the meeting when Rev. S. D. Peet, of the *American Antiquarian*, commenced his observations upon Effigy Mounds, The Clan System among the Mound Builders, Did the Cherokees build in the Scioto Valley? and The Mounds in the Mississippi Bottoms used as Refuges in times of High Water. These will probably appear in the *Antiquarian*.

The closing general session was held in the auditorium Tuesday evening.

Prof. T. E. Mendenhall, of Terre Haute, Ind., was chosen President for the next meeting, which is to be held in 1889 at Toronto, Canada.

The Vice-President chosen for section H was Col. Garrick Mallery, of the Bureau of Ethnology, Washington, and for Secretary, Rev. W. M. Beauchamp, of Baldwinsville, New York.

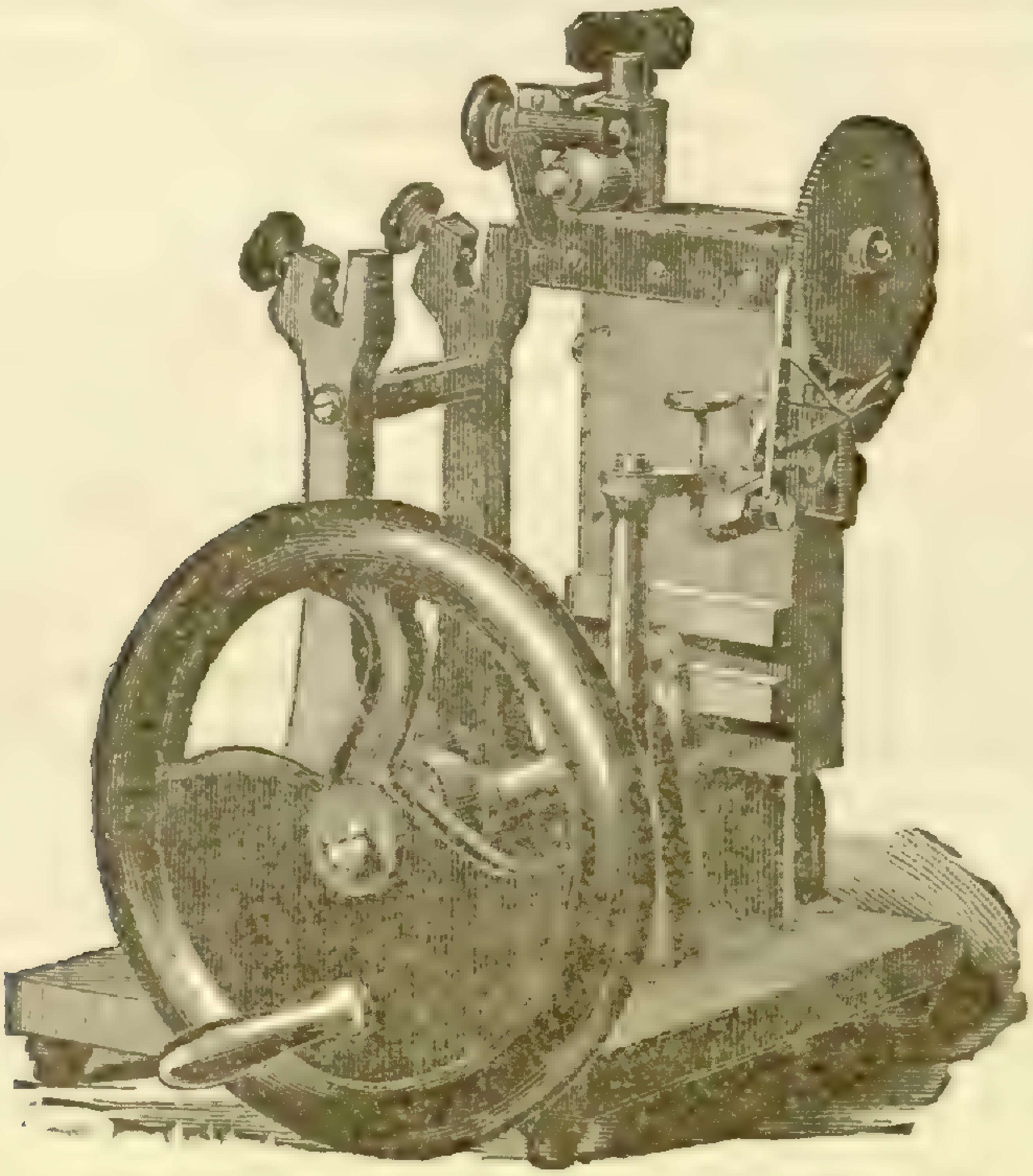
The committee appointed at last general meeting to secure from Congress the abolition of the customs duties on scientific books and apparatus, made a lengthy report in favor thereof.

The committee on the preservation of archæologic monuments on public lands reported in favor of the following as proper subjects for preservation: Chaco cañon from the forks of Escavoda cañon for a distance of eight miles up, also one mile back from the brink of the cañon walls on each side so as to include many interesting structures. Cañon de Chelly, Cañon del Muerto, Walnut cañon, the ruin on Fossil creek on east branch of the Rio Verde and about fifteen miles south of Camp Verde military reservation, the ruin in Mancos cañon, the round towers in the flat valleys of the lower Mancos, the cave lodges in the cinder cone about eight miles east of Flagstaff, A. T. Besides these groups of ruins and dwellings there are isolated remains in the territories of New Mexico, Arizona and Utah numbering over forty, which demand preservation. The Pueblos, which are not in treaty reservations or grants, and the old Mandan and Arickaree village on the Fort Berthold Indian reservation, D. T., to be preserved when they shall cease to be inhabited by Indians. And the committee was continued.

After the usual resolutions and speeches of thanks and acknowledgements to the local committee and to the citizens of Cleveland, the meeting adjourned *sine die*.

MICROSCOPY.[1]

Minot's Automatic Microtome.—The principle of this Microtome is to obtain sections by moving the object to be cut in a vertical plane past the knife which is held in a fixed position. The knife is clamped by two screws in jaws at the top of two upright pillars to be seen in the figure. The object to be cut is imbedded in paraffine and stuck on to a circular brass plate which faces the knife, when the plate is in position. This plate has the motion in three directions, and may be revolved around its own centre, so that the position of the object may be adjusted as desired. The well-known construction, used on the Schanze Machines, has been adopted to secure the necessary play of movement for the plate,



carrying the paraffine. This construction was selected on account of its simplicity and convenience, and the great firmness with which the plate may be clamped. The object holder rests on a horizontal plate which may be fed towards the knife by a micrometer screw, the head of which is a toothed wheel. *Each tooth equals $\frac{1}{300}$ mm. forward movement.* The whole of this complete object-carrier is fastened to an upright slide. The slide is worked up and down by a crank, as seen in the cut, and the crank is moved by turning a heavy iron wheel.

[1] Edited by C. O. Whitman, Director of the Lake Laboratory, Milwaukee, Wis.

When the wheel is revolved, the crank is turned, and the upright slide rises and falls in a vertical plane, and of course the object-carrier, with its micrometer screw, rises and falls with it. As the carrier rises a lever connected with a pawl strikes against a screw on a separate pillar; the pawl catches in the toothed wheel-head of the micrometer screw and so turns it, and moves the paraffine towards the knife. As the carrier descends a section is cut off, when it is near the top of its upward excursion, the micrometer screw is turned by the pawl, and the next descent produces another section. By simply turning the screw against which the pawl lever strikes, the number of teeth caught by the pawl, and therefore the thickness of the sections may be varied from 1-300 to 1.33 of a millimeter.

This microtome has been devised to avoid the obvious inconveniences attaching to the rocking and other automatic microtomes.

Since the first lot of these microtomes were placed in the market, some important improvements have been made, among which may be mentioned the strengthening of the upright slide in which the carrier moves. This improvement secures regularity and precision in the movement of the object, and renders the microtome one of the best for paraffine-cutting now in the market. This microtome, with one knife in case, is supplied by the Educational Supply Company, 6 Hamilton Place, Boston.

The Eyes of Scorpions.[1]—In the median eyes, by careful dissection, the soft part may be separated from the lens and cuticula, and cut without the interference of these hard structures. The separation is best accomplished after the tissues have been hardened. This method of dissection cannot be applied to the lateral eyes, for they are almost completely surrounded by chitine. In these eyes the best results were obtained by trimming off the chitine around the eyes, and cutting the retina and the lens after the removal of as much chitine as possible.

The pigment is so abundant and so dense that even the thinnest sections cannot be studied to advantage until they have been depigmented. For this purpose I know of only two classes of successful reagents, acids and strong alkalis. Grenacher has generally employed the first, Graber the second.

Of the acid reagents strong solutions are required. Lankester and Bourne employed 5 or 10 per cent. solutions of nitric acid. In the eyes which I have studied, this mixture did not remove the pigment, even after the lapse of a week; and I was forced to use stronger and stronger grades, till 50 per cent. was reached. This mixture gives fair results, but must be made and used with caution. *A given volume of acid should be poured slowly into an*

[1] G. H. Parker, "The Eyes in Scorpions." Bull. Mus. Comp. Zool., vol. xiii., No. 6, pp. 174–177. Dec., 1887.

equal measure of alcohol, never the reverse, and the mixture should be kept cool, otherwise the acid may attack the alcohol. In such an event the solution is rendered worthless, and, should the specimens be in it at the time, the heat generated by the reaction gives the acid such additional dissolving power that the sections are at once destroyed. A more efficient acid reagent is a mixture of equal parts hydrochloric and nitric acids. A 35 per cent. solution of this mixture in strong alcohol gives better results than the pure nitric acid at 50 per cent., and does not so readily attack the alcohol.

Of the alkalis, weak ammonia, sodic hydrate, and potassic hydrate are most serviceable. The solids are to be preferred to the ammonia, since from them solutions of a definite strength can more easily be made. An aqueous solution of $\frac{1}{3}$ or $\frac{1}{4}$ per cent. potassic hydrate has given the most satisfactory results.

The method of using the depigmenting fluid is as follows. Unstained material is cut in paraffine; the ribbons are mounted on a slide with Schällibaum's fixative; when the sections are fixed, the paraffine is removed with turpentine; the slide with the sections is then successively washed with alcohol of 98 per cent., 90 per cent., 70 per cent., and so on, till a grade homogeneous with the depigmenting fluid is reached. Into a shallow white dish filled with the depigmenting fluid the slide is now gently lowered. In a *few seconds* the pigment, dissolving, will be seen as a reddish cloud. The process is usually completed in less than a minute, and the slide is promptly transferred to a dish of clean water or alcohol and there gently rinsed. The sections are next stained by exposure to the dye in a shallow dish. After being sufficiently stained, they may be washed and mounted in glycerine, or, after the proper steps in dehydrating and clarifying, mounted in benzol-balsam or other mounting medium.

The dyes which have been found the most serviceable are some of the carmines and hæmatoxylin. The aniline dyes have almost invariably given poor results. For general purposes Grenacher's alcoholic borax-carmine is excellent. In both embryonic and adult material Czoker's alum-cochineal gave fine nuclear outlines. In the adult eyes, the rhabdomes and the cell boundaries were most distinctly shown by Kleinenberg's hæmatoxylin. A very faint coloration with this dye gave the best results for nerve-fibres.

For the isolation of the retinal elements two maceration fluids were used. A weak solution of chromic acid, as employed by Patten, gave good results; but since the mycelium of a fungus is often developed in very dilute solutions of this reagent, it can be used only when it is carefully watched and its results are controlled by another method. It was employed in the following manner. The retina, after the removal of the lens and surrounding tissue, was placed for five or ten minutes in a $\frac{1}{5}$ per cent. solution. After this treatment,

which slightly hardened the tissues, the first solution was replaced by a second of $\frac{1}{50}$ per cent. In this the retina remained for three or four days, at the end of which time the retinal cells were easily separable. The most satisfactory method of isolating the cells is to place on a slide in dilute glycerine a small portion of the macerated retina, and, having protected it with a cover-glass raised on wax feet, to gently tap the cover-glass till the cells are separated. One part of 0.2 per cent. solution of acetic acid in sea-water mixed with an equal volume of 0.04 per cent. osmic acid in sea-water, although only partially successful as a maceration fluid for the retina in scorpions, is a reliable check for the results obtained from chromic acid.

After the cells have been isolated, the abundance of pigment which they contain so obscures their contents that scarcely more than their outlines can be studied. The removal of the pigment is on the whole more successfully accomplished before than after isolation. For this process, as for simple isolation, the retina should be subjected to the action of $\frac{1}{5}$ per cent. chromic acid for five or ten minutes, and then transferred to a solution of $\frac{1}{3}$ per cent. potassic hydrate. In this the pigment dissolves, forming a reddish cloud. After about a minute the retina should be removed to distilled water, rinsed, and transferred to Grenacher's alcoholic borax-carmine. This reagent performs both the office of a maceration fluid and a dye. In from twelve to twenty-four hours the retinal cells can be isolated, and present in different regions of the retina three principal conditions. First, those from the exterior of the retina are seriously altered by the continued action of the potash; second, those from the centre of the retina remain almost unchanged, still retaining most of their pigment; third, those from an intermediate position, without being otherwise much altered, lose most of their pigment. It is from these last that the best results were obtained.

SCIENTIFIC NEWS.

—The President has directed Maj. George M. Sternburg, Surgeon U. S. A., to proceed to Decatur, Ala., and to such other points as he may deem necessary to continue his scientific investigations of the yellow fever.

—Among the works announced for immediate publication are: "Essays," by Prof. Huxley; "Wild Beasts and their Ways," by Sir Samuel Baker; "On Truth—a Fundamental Inquiry touching upon Various Popular and Scientific Beliefs," by Prof. St. George Mivart; "Mental Evolution in Man," by Dr. George J. Romanes; "Nature and Man," by the late W. B. Carpenter; "A Personal Narrative of the Euphrates Expedition," by Rev. W. F. Ainsworth.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Biological Society of Washington.—*October 20th.*—The following communications were read: Mr. L. O. Howard, "An Apparatus for the Study of Underground Insects and Plant-Roots;" Professor Lester F. Ward, "The King Devil;" Mr. J. B. Smith, "Some Remarks on Sexual Characters in *Lachnosterna;*" Dr. Theo. Gill, "The Families of Fishes."

International Congress of Geologists.—This body met in London on Monday, September 17th, and closed its sessions Saturday, September 22d. After its close, five excursions occupied several days.

September 17th, Monday evening.—Address by Professor Prestwich, followed by reception by Professor and Mrs. Prestwich.

September 18th, Tuesday morning.—Regular opening. Reports of Committee upon Nomenclature. Discussion of Nomenclature of Cambrian and Silurian systems especially, and as to the value of the proposed *Orthrocene.* (See Prestwich's Address, page 9.)

September 19th, Wednesday morning.—Discussion of Crystalline Schists. Afternoon, reception by Professor Flower in Natural History Museum. Evening, reception by Director Geikie in School of Mines, Jermyn Street.

September 20th, Thursday.—Discussion of the Nomenclature of

the Geological Map of Europe. In the afternoon, excursions to Windsor and to Eton, by invitation of the Professors of Eton College; to Kew, and to Erith, Crayford, etc.

September 21st, Friday.—In the afternoon, reception at the rooms of the Geological Society, Burlington House, by the President, Dr. W. T. Blanford.

The results of the congress are thus summed up by the President, Professor Prestwich:—

He said: We approach the end of the congress, and we can now congratulate ourselves upon the results obtained. The first sitting was devoted to the discussion on the divisions of the Cambrian and Silurian systems, and although no vote has been taken, the opinions expressed have demonstrated that all are in accord for retaining the three groups or zones of Barrande and Murchison. But the necessity is not seen of making, as some members proposed, the intermediate zone a separate system. Thus the *status quo* of the Upper and Lower Silurian for the beds as far as the Tremadoc, and of the Cambrian for the group below, will not be affected. Two sittings have been devoted to the discussion on the origin of the crystalline schists by hydrothermal chemical action or by movements, for each of which causes powerful arguments have been advanced. The congress had received and printed in advance memoirs by eminent geologists, which will be valuable documents in the solution of this important problem. Another sitting took cognizance of the connection between the Tertiary and the Quaternary, the result of which is that, although opinions are divided, the majority of members approve of retaining the term Quaternary. Although in these cases votes had not been taken, the discussions had a great interest in the demonstration of the ideas which predominated among the most distinguished geologists. According to the resolutions adopted by the Committee on Voting, it will be easier in the future sessions to arrive at more positive conclusions. The reports which the Committee of Nomenclature has received from the national committees, and which are printed, are of great importance, and will serve as bases for a more settled classification. It is to be regretted also that the great palæontological work of all the known fossils is about to be abandoned for the present, by reason of the great expenses which it involves. One of the most important objects of the congress has been brought to a conclusion—the unification of colors and shadings in maps, and the Committee on the Geological Map of Europe announce to us that the publication of this fine map will not be delayed.

Some six hundred members were registered, of whom one hundred and forty-two were from countries other than Great Britain. The Americans present were Messrs. Dall, Fraser, Gilbert, Marsh,

Newberry, Osborn, Walcott, Williams, of Cornell, and Williams, of Johns Hopkins.

Invitations to hold the next meeting were received from Philadelphia, New York, and Washington. Philadelphia was chosen.

American Philosophical Society.—*January 20, 1888.*—Prof. Cope presented for publication the following papers:

(1) "Synopsis of the Vertebrate Fauna of the Puerco Epoch of North America."

(2) "Lemurine Reversion in Human Dentition."

(3) "The Shoulder-girdle and Limbs of Eryops."

February 3.—Dr. Horn exhibited seven species of Pleocoma from California, of which three were new, and supported the views of the late Dr. Le Conte of the position of this genus, which he insisted was a Laparostict, and not a Pleurostict Lamellicorn.

February 17.—Prof. Cope presented for publication papers upon "The Dicotylinæ of the John Day Miocene of North America," and upon "The Mechanical Origin of the Dentition of the Amblypoda."

March 2.—Prof. T. B. Stowell presented papers on "The Hypoglossal, Accessory and Glosso-pharyngeal Nerves of the Domestic Cat;" and Mr. F. Jordan an article on "The Aboriginal Pottery of the Middle Atlantic States."

March 16.—Dr. Frazer made a communication respecting the geology of the eastern part of Cuba, reporting the probable occurrence of a large part of the Archæan rocks which lie between the Lower Laurentian and the Palæozoic. Miss H. C. de S. Abbott made some remarks upon the occurrence of a "Series of New Crystalline Compounds in Higher Plants."

Mr. H. Phillips, Jr., presented a first contribution to the "Folklore of Philadelphia and its Vicinity;" and Dr. O. Meyer a paper on "The Miocene Invertebrates from Virginia." Mr. Phillips also reported on the "Langue Internationale" of Dr. Samenhof, of Moscow.

April 6.—Mr. Law presented a paper on "Gildas and Early English History," and Prof. E. J. Houston made an oral communication upon "Death by the Electric Current," in which he held that the fatality largely depended upon the part of the body brought in contact with the wires. Prof. Houston also reported favorably upon the Paillard Palladium alloys in watches as a preservative against the effects of magnetism.

April 20.—Prof. Houston presented a paper upon "Some Possible Methods for the Preparation of Gramophone and Telephone Records." Mr. Phillips exhibited a specimen of Physa found from the pipes of the drinking supply, and this was followed by a discussion of the water-supply of cities.

May 4.—The Magellanic medal was presented to Prof. L. M.

Haupt for his paper upon "The Physical Phenomena of Harbor Entrances."

The following papers were presented: "On the Classification and Nomenclature of the Metalline Minerals," by Dr. T. Sterry Hunt; "On the Ear-bones of the Permian Batrachia," by Prof. E. D. Cope; and on "Two New Species of Ophidia from Mexico," by Dr. A. Dugés.

September 7.—The following papers were presented:

"Ibrahim Nukim, ein Guslarenlied der Herzegovina," by Dr. E. S. Krauss (Vienna); "Action of the Gas from As_2O and HNO upon m-Oxybenzoic Acid," by Prof. E. A. Smith; on the "Cretaceous and Tertiary of the Sergipe Alagias Basin of Brazil," by Prof. J. C. Branner.

September 21.—Dr. H. A. Hare presented for the Transactions a paper on the "Diseases of the Mediastinum."

October 5.—Dr. D. G. Brinton read a paper on the "Language of Palæolithic Man."

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CRETACEOUS FLORAS OF THE NORTHWEST TERRITORIES OF CANADA.

BY WILLIAM DAWSON.[1]

GEOLOGICAL RELATIONS OF THE FLORAS.

IN my memoir in the First volume of the Transactions of this Society, I have given a table of the formations prepared by Dr. G. M. Dawson, and have fully stated the geological position of the plants at that time described. The new facts above detailed now require us to intercalate in our table three distinct plant horizons not previously recognized in the western territories of Canada. One of these, the Kootanie series, should probably be placed at the base of the table as a representative of the Urgonian or Neocomian, or, at the very least, should be held as not newer than the Shasta group of the United States Geologists, and the Lower Sandstones and Shales of the Queen Charlotte Islands. It would seem to correspond in the character of its fossil plants with the oldest Cretaceous floras recognized in Europe and Asia, and with that of the Komé formation in Greenland, as described by Heer. No similar flora seems yet to have been distinctly recognized in the United States, except, perhaps, that of the beds in Maryland, holding cycads, and which were referred many years ago by Tyson to the Wealden.

[1] This paper states the general conclusions of a memoir, by Sir William Dawson, in the Transactions of the Royal Society of Canada, which will appear with descriptions and illustrations of the new species in the course of next winter.

The second of these plant horizons, separated according to Dr. G. M. Dawson, by a considerable thickness of strata, is that which he has called the Mill Creek series, and which corresponds very closely with that of the Dakota group, as described by Lesquereux, and that of the Atané and Patoot formations in Greenland, as described by Heer. This fills a gap indicated only conjecturally in the section of 1883. Along with the plants from the Dunvegan group of Peace River, described in 1883, it would seem to represent the flora of the Cenomanian and Senonian divisions of the Cretaceous in Europe.

Above this we have also to intercalate a third sub-flora, that of the Belly River series at the base of the Fort Pierre group. This, though separated from the Laramie proper by the marine beds of the Pierre and Fox Hill groups, more than 1,700 feet in thickness, introduced the Laramie or Danian flora, which continues to the top of the Cretaceous, and probably into the Eocene, and includes several species still surviving on the American continent, or represented by forms so close that they may be varietal merely.

Lastly: the subdivision of the Laramie group, in the last report of Dr. G. M. Dawson, into the three members known respectively as the Lower or St. Mary River series, the Middle or Willow Creek series, and the Upper or Porcupine Hill series, in connection with the fact that the fossil plants occur chiefly in the lower and upper members, enables us now to divide the Laramie flora proper into two sub-floras, an older, closely allied to the underlying Belly River series; and a newer, identical with that of Souris River, described as Laramie in Dr. G. M. Dawson's Report on the 48th Parallel, 1876, and in the Report of the Geological Survey of Canada for 1879, and which appears to agree with that known in the United States as the Fort Union group, and with the so-called Miocene of Heer from Greenland.

From the animal fossils and the character of the flora, it would seem probable that the rich flora of the Cretaceous coal fields of Vancouver Island is nearly synchronous with that of the coal-bearing Belly River series of the western plains.

It will thus be seen that the explorations already made in Canadian territory have revealed a very complete series of Cretaceous plants, admitting, no doubt, of large additions to the number of species by future discoveries, and also of the establishment of con-

necting links between the different members, but giving a satisfactory basis for the knowledge of the succession of plants and for the determination of the ages of formations by their vegetable fossils.

The successive series may be tabulated as follows, with references for details to the fuller table in my memoir of 1883:—

SUCCESSIVE FLORAS AND SUB-FLORAS OF THE CRETACEOUS IN CANADA.

(IN DESCENDING ORDER.)

PERIODS.	FLORAS AND SUB-FLORAS.	REFERENCES.
Danian	Upper Laramie and Porcupine Hill Series	Platanus beds of Souris River and Calgary. Report Geol. Survey of Canada for 1879, and present memoir.
	Middle Laramie or Willow Creek Series.	
	Lower Laramie or St. Mary River Series	Lemna and Pistia beds of bad lands of 49th Parallel, Red Deer River, etc., with Lignites. Report 49th Parallel and this memoir.
Senonian	Fox Hill Series	Marine.
	Fort Pierre Series	Marine.
	Belly River Series. (See note)	Sequoia and Brasenia beds of S. Saskatchewan, Belly River, etc., with Lignites. This memoir.
	Coal Measures of Nanaimo, B.C., probably here	Memoir of 1883. Many Dicotyledons, Palms, etc.
Cenomanian	Dunvegan Series of Peace River. (See note)	Memoir of 1883. Many Dicotyledons, Cycads, etc.
	Mill Creek Series of Rocky Mountains	Dicotyledonous leaves, similar to Dakota Group of the U. S. This memoir.
Neocomian & Urgonian	Suskwa River and Queen Charlotte Island Series. Intermediate Series of Rocky Mountains	Cycads, Pines, a few Dicotyledons. Report Geol. Survey. This memoir.
	Kootanie Series of Rocky Mountains	Cycads, Pines and Ferns. This memoir.

NOTE.—Though the flora of the Belly River Series very closely resembles that of the Lower Laramie, showing that similar plants existed throughout the Senonian and Danian periods in North America, yet it is to be anticipated that specific differences will develop themselves in the progress of discovery. In the meantime it scarcely seems possible to distinguish by fossil plants alone the Lower Laramie beds from those of Belly River, and if these are really separated by 1,700 feet of marine strata, as is now believed on stratigraphical grounds, the flora must have been remarkably persistent. The Dunvegan series of Peace River probably corresponds in time with the Marine Niobrara Group farther South.

In connection with the above table it should be understood that Tertiary floras, probably Miocene in age, are known in the interior of British Columbia, though they have not yet been recognized in the territories east of the Rocky Mountains.

Before leaving this part of the subject I would deprecate the remark which I see occasionally made, that fossil plants are of little value in determining geological horizons in the Cretaceous and Tertiary. I admit in these periods some allowance must be made for local differences of station, and also that there is a generic sameness in the flora of the Northern Hemisphere, from the Cenomanian to the modern, yet these local differences and general similarity are not of a nature to invalidate inferences as to age. No doubt palæobotanists seem obliged, in deference to authority, and to the results of investigations limited to a few European localities, to group together, without distinction, all the floras of the later Cretaceous and earlier Tertiary, irrespective of stratigraphical considerations, the subject lost its geological importance. But when a good series has been obtained in any one region of some extent, the case becomes different. Though there is still much imperfection in our knowledge of the Cretaceous and Tertiary floras of Canada, I think the work already done in Canada in connection with that of Lesquereux and Newberry in the United States, is sufficient to enable any competent observer to distinguish by their fossil plants the Lower, Middle and Upper Cretaceous, and the latter from the Tertiary.

PHYSICAL CONDITIONS AND CLIMATE INDICATED BY THE CRETACEOUS FLORAS.

In the Jurassic and earliest Cretaceous periods the prevalence, over the whole of the Northern Hemisphere and for a long time, of a monotonous assemblage of gymnospermous and Acrogenous plants, implies a uniform and mild climate and facility for intercommunication in the north. Toward the end of the Jurassic and the beginning of the Cretaceous, the land of the Northern Hemisphere was assuming greater dimensions, and the climate probably becoming a little less uniform. During the close of this period or at the beginning of the next, the dicotyledonous flora seems to have been introduced, under geographical conditions which permitted a warm temperate climate to extend as far north as Greenland.

In the Cenomanian, we find the Northern Hemisphere tenanted with dicotyledonous trees closely allied to those of modern times, though still indicating a climate much warmer than that which at present prevails. In this age, extensive but gradual submergence of land is indicated by the prevalence of chalk and marine limestones over the surface of both continents; but a circumpolar belt of land seems to have been maintained, protecting the Atlantic and Pacific basins from floating ice, and permitting a temperate flora ot great richness to prevail far to the north, and especially along the southern margins and extensions of the circumpolar land. These seem to have been the physical conditions which terminated the existence of the old Mesozoic Flora and introduced that of the Middle Cretaceous.

As time advanced, the quantity of land gradually increased, and the extension of new plains along the older ridges of land was coincident with the deposition of the great Laramie series, and with the origination of its peculiar flora, which indicates a mild climate and considerable variety of station in mountain, plain and swamp, as well as in great sheets of shallow and weedy fresh water.

In the Eocene and Miocene periods the continent gradually assumed its present form, and the vegetation became still more modern in aspect. In that period of the Eocene, however, in which the great nummulitic limestones were deposited, a submergence of land occurred on the Eastern continent which must have assimilated the physical conditions to those of the Cenomanian. This great change, affecting materially the flora of Europe, was not proportionately great in America, which also by the north and south extension of its mountain chains permitted movements of migration not possible in the Old World. From the Eocene downwards, the remains of land animals and plants are found only in lake basins occupying the existing depressions of the land, though more extensive than those now existing. It must also be borne in mind, that the great foldings and fractures of the crust of the earth which occurred at the close of the Eocene, and to which the final elevation of such ranges as the Alps and the Rocky Mountains belongs, permanently modified and moulded the forms of the continents.

These statements raise, however, questions as to the precise

equivalence in time of similar floras found in different latitudes. However equable the climate, there must have been some appreciable difference in proceeding from north to south. If, therefore, as seems in every way probable, the new species of plants originated on the Arctic land and spread themselves southward, this latter process would occur most naturally in times of gradual refrigeration or of the access of a more extreme climate, than is in times of the elevation of land in the temperate latitudes, or conversely, of local depression of land in the Arctic, leading to invasions of northern ice. Hence the times of the prevalence of particular types of plants in the far north would precede those of their extension to the south, and a flora found fossil in Greenland might be supposed to be somewhat older than a similar flora when found farther south. It would seem, however, that the time required for the extension of a new flora to its extreme geographical limit, is so small in comparison with the duration of an entire geological period that practically, this difference is of little moment, or at least does not amount to antedating the Arctic flora of a particular type by a whole period, but only by a fraction of such period.

It does not appear that during the whole of the Cretaceous and Eocene periods there is any evidence of such refrigeration as seriously to interfere with the flora, but perhaps the times of most considerable warmth are those of the Dunvegan group in the Middle Cretaceous and those of the later Laramie and Palæocene.

It would appear, that no cause for the mild temperature of the Cretaceous needs to be invoked, other than those mutations of land and water which the geological deposits themselves indicate. A condition for example of the Atlantic basin in which the high land of Greenland should be reduced in elevation and at the same time the northern inlets of the Atlantic closed against the invasion of Arctic ice, would at once restore climatic conditions allowing of the growth of a temperate flora in Greenland. Dr. Brown has shown,[1] and, as I have elsewhere argued, the absence of light in the Arctic winter is no disadvantage, since, during the winter, the growth of deciduous trees is in any case suspended, while the constant continuance of light in the summer is, on the contrary, a very great stimulus and advantage.

[1] Florula Discana.

It is a remarkable phenomenon in the history of the genera of plants in the later Mesozoic and Tertiary, that the older genera appear at once in a great number of specific types, which become reduced as well as limited in range down to the modern. This is, no doubt, connected with the greater differentiation of local conditions in the modern; but it indicates also a law of rapid multiplication of species in the early life of the genera. The distribution of the species of *Salisburia, Sequoia, Platanus, Sassafras, Liriodendron, Magnolia,* and many other genera, affords remarkable proofs of this.

Gray, Saporta, Heer, Newberry, Lesquereux and Starkie Gardner, have all ably discussed these points; but the continual increase of our knowledge of the several floras, and the removal of error as to the dates of their appearance, must greatly conduce to clearer and more definite ideas. In particular, the prevailing opinion that the Miocene was a period of great extension of warmth and of a temperate flora into the Arctic, must be abandoned in favor of the later Cretaceous and Eocene; and if I mistake not, this will be found to accord better with the evidence of general geology and of animal fossils.

ON THE INFLUENCE OF CIRCUMSTANCES ON THE ACTIONS AND HABITS OF ANIMALS, AND THAT OF THE ACTIONS AND HABITS OF LIVING BODIES, AS CAUSES WHICH MODIFY THEIR ORGANIZATION.

BY J. B. P. A. LAMARCK.[1]

THE question here is not one of reasoning, but the examination of a positive fact, which is more general than is thought, and to which people have neglected to give the attention which it merits without doubt because, often, it is very difficult to recognize. This fact consists in the influence exercised by circumstances on the different living bodies, which find themselves subjected to them. In fact, the influence of different states of our organism on our character, our inclinations, our actions, and also our ideas, has been long remarked; but it seems to me no one yet has recognized what influence our actions and our habits have upon our organization itself. Now, as these actions and these habits depend entirely upon the circumstances in which we habitually find ourselves, I will attempt to point out how great is the influence which circumstances exercise on the general form, on the condition of parts, and thus upon the organization of living bodies. It is this very certain fact which is the question discussed in this chapter.

If we had not had numerous opportunities to recognize clearly the effect of these influences on certain living bodies which we have placed in altogether new circumstances, and very different from those to which they were accustomed, and if we had not seen the effects and changes which have resulted, exhibiting themselves in many ways, under our eyes, the important fact in question would always have remained unknown to us.

The influence of circumstances manifesting itself in bodies possessing life, is effectual in all time and everywhere; but that which renders this influence difficult for us to perceive, is that these effects

[1] Constituting the Chap. VII., Vol. I., of the Philosophie Zoölogique. Translated for the American Naturalist by Dr. Eleanor E. Galt, from the edition of 1809.

only become sensible or recognizable (especially among animals) after a long time.

Before showing and examining the proofs of these facts, which deserve our attention, and which are of great importance to Philosophical Zoology, let us again take up the thread of considerations which we have already had in hand.

In the preceding chapter we have seen that it is at present an incontestable fact that in considering the animal scale in an inverse sense to that of nature, we find that there exists in the bodies which compose this scale a continual but irregular degradation in the organization of the animals which compose it; a growing simplification of the organization of living bodies, and finally a proportional diminution in the number of faculties of these beings.

This well-known fact throws the greatest light upon the order which nature has followed in the production of all existing animals; but it does not point out to us why the organization of animals in its growing constitution, from the most imperfect up to the most perfect, shows only irregular gradation, of which the facies presents numerous anomalies or digressions, having no appearance of order in their diversity.

Now, in searching for the reason of this singular irregularity in the growing constitution of the organization of animals, if we consider the result of the influence which circumstances, infinitely diversified in all parts of the globe, exercise on the general form, the parts, and the organization itself of the animals, all then will be clearly explained.

It will be, in fact, evident that the state in which we see all animals, is, on one side, the product of the growing constitution of the organization which tends to form a regular gradation, and, on the other side, that it is the influence of a multitude of very different circumstances which are tending continually to destroy the regularity in the gradation of the growing constitution of the organization.

Here it becomes necessary to explain myself as to the meaning which I attach to these expressions: *The circumstances influence the form and organization of animals,* that is to say, that in becoming very different they change in time both their form and their organization itself, by proportional modifications. Surely, if these

expressions were taken literally, an error would be ascribed to me; for, whatever the circumstances might be, they would not produce directly any modification whatever in the form and organization of the animals.

But great changes in circumstances bring among animals great changes in their wants, and changes in their wants necessarily bring parallel modifications into their actions. Now, if the new wants become constant or very lasting, the animals will adopt new habits, which are as permanent as the wants which produced them. This is a fact easy of demonstration, such as requires no explanation to be appreciated.

It is then evident that a great change in circumstances becoming constant in a race of animals, entails upon these animals new habits.

Now, if new circumstances becoming permanent with a race of animals, have given to these animals new habits; that is to say, have forced them to new actions, which have become habitual, the consequence will be the employment of some part, in preference to some other part, and in certain cases the total lack of employment of a part which has become useless.

Nothing of all this should be considered as an hypothesis, or as a private opinion; they are, on the contrary, truths which, in order to be rendered evident, require only attention and observation of facts. We shall see directly by the citation of known facts, which prove, on one side, that new wants, having rendered a certain part necessary, have really by repeated efforts created this part, and in consequence of repeated employment have little by little strengthened and developed them, and have resulted in a considerable increase of size. On the other hand, we shall see that in certain cases new circumstances and new wants having rendered a certain part entirely useless, the total lack of employment of that part has caused its growth gradually to cease; that it becomes small and attenuated little by little, and that finally, when this lack of employment has been total for a long time, the part in question disappears.

All this is certain, and I now propose to give the most convincing proof. In vegetables, which have no movements, and in consequence no habits, properly speaking, great changes of circumstances

bring great differences in the development of their parts, so that these differences create and develop some of them, whilst they diminish and abolish others.

But here all goes on by changes wrought in nutrition of the vegetable, in its absorptions and its respirations, in the quantity of caloric, of light, of air and humidity, which it then habitually receives; finally in the superiority which certain of the diverse vital movements may exercise over the others.

Among individuals of the same species, some of which are continually well nourished, and under circumstances favorable to their development, while others are subjected to opposite conditions, there will be produced a difference of development which gradually becomes very well marked. How many examples could I not cite in regard to animals and vegetables which would confirm this assertion! Now, if circumstances remaining the same, render the state of badly nourished, suffering or languishing individuals habitual and constant, their interior organization is finally modified; and reproduction among these individuals in question preserves these acquired modifications, and at last gives origin to a race very distinct from that whose individuals are found continually in circumstances favorable to their development. A very dry spring is the reason why the grasses of a meadow grow very little and are meagre and mean, although they blossom and fruit. A spring time of warm and rainy days causes the same grasses to take on much growth, and the harvest of hay is then excellent. But if any cause perpetuates unfavorable circumstances for these plants, they will vary proportionally, at first in their appearance or general condition, and finally in various particulars of their characters. For example, if some seed of any one of these grasses of the meadow in question, be transferred to an elevated locality, dry, arid, stony, and much exposed to winds, and there germinate, the plant which will live in this locality, though always badly nourished, and the individuals which it reproduces then continuing to exist under these adverse circumstances, there will result a species very different from the species living in the meadow, from which it has originated. The individuals of this new race would be small, slender in their parts, and certain of their organs having developed more than others, would then present peculiar proportions.

Those who have observed much, and who have consulted great collections, have been able to convince themselves that, according as the circumstances of habitat, of exposure, climate, nourishment and habit of life, etc., change; the characters of size, form, proportion of parts, color, consistence, activity and labors, of animals change in proportion. That which nature does slowly we can do every day, by changing suddenly, in the case of a living vegetable, the circumstances by which it and all the individuals of its kind are surrounded. All botanists know that vegetables which are taken from their native place into gardens to be cultivated, gradually undergo changes which render them finally unrecognizable. Many plants naturally very hairy become smooth, or nearly so; numbers of those which were creeping and trailing, straighten their stems; others lose their spines or their roughness; still others possessing woody and long-lived (perennial) stems in warm climates which they inhabited, pass, in our country, into an herbaceous state (many are only annual plants); finally the dimensions of their parts undergo very considerable changes. These effects of changes of circumstances are so well known that botanists do not like to describe garden plants unless they have been recently cultivated. Is not cultivated wheat (*Triticum sativum*) a vegetable, brought by man to the state in which we actually see it? Who can tell me in what country a like plant has its habitat without being there the result of culture? Where do we find in nature our cabbages, our lettuces, etc., in the state in which we possess them in our kitchen gardens? Is it not the same in regard to many animals which domestication has changed or considerably modified? How many different races among our poultry and domestic pigeons have we procured by raising them under diverse circumstances and in different countries, and how vain would be our search to find such in nature! Those which are the least changed, without doubt by less ancient domestication, and because they do not live in a climate strange to them, present no less, in the condition of certain of their parts, great differences, produced by habits which we have caused them to contract. Thus our domestic ducks and geese find their type in wild ducks and geese; but ours have lost the power to rise high in the air, and to traverse great distances by flying; there has been, in fact, a real change in the state of their parts, com-

pared with those animals of the race from which they came. Who does not know that any bird of our climate which we have raised in a cage, and which has lived there five or six years, continuously, when liberated is not able to fly as its kind who have always been free? This trifling change of circumstance acting on this individual, has in truth only diminished its faculty of flight, and without doubt has made no change in the form of the parts of the individuals. But if successive generations of individuals of the same race had been held in captivity during a considerable time, there is no doubt that even the form of the parts would little by little have undergone notable changes. A stronger reason yet, if instead of a simple captivity maintained in regard to them, this circumstance has been for some time accompanied by a change of very different climate, and that these individuals by degrees had been habituated to other kinds of food, and to other movements to get it, certainly these circumstances united and become constant would have formed insensibly a new race altogether peculiar. Where is found now in nature the multitude of races of dogs which, in consequence of the domestication to which we have reduced them, have been brought into the condition in which they are at present? Where are found the bulldogs, greyhounds, spaniels and lapdogs, etc., races which show in themselves greater differences than those which we would admit as specific among animals of the same genus living at liberty in nature?

Without doubt a first and unique race, first cousin of the wolf, if not himself the true type, has been some time tamed and domesticated by man. This race, which showed at that time no difference among the individuals, has been gradually dispersed with man into different countries and into different climates, and after having long submitted to the influence of the places of habitation and the diverse habits which they have been made to contract in each country, they have experienced remarkable changes and have formed peculiar races. Now man, for the sake of commerce or for other interests, travels great distances; and having transported into well-peopled places, as a great capital, different races of dogs bred in countries far apart, and then crossed them, he has by generation given origin successively to all these which we now know.

The following fact proves, in regard to plants, how the change

of some important circumstance acts to change the parts of these living bodies. While *Ranunculus aquatilis* is immersed in water its leaves are all finely divided and the divisions are capillary, but when the stems of this plant reach the surface of the water, the leaves which develop in air are enlarged, rounded and simply lobed. If some root of this plant succeeds in pushing itself into a soil only damp, without being covered by water, the stems are short, and none of the leaves are parted into capillary lobes; it is called the *Ranunculus hederaceus,* which botanists regard as a species when they encounter it. There is no doubt that, in regard to animals, important changes in the circumstances in which they are in the habit of living, produce changes likewise in their parts, but here the mutations are slower in being brought about than in vegetables, and in consequence are less evident to us, and their cause less recognisable. Among the circumstances which have so much power to modify the organs of living bodies, the most influential are, without doubt, the diversity of places which they inhabit; but besides these are many others which have considerable influence in the production of the results in question. It is known that different places change nature and quality on account of their position, of their constitution, and of their climate. This is easily observed in visiting different places distinguished by these particular qualities. Behold, then, one cause of variation of animals and of vegetables which live in these diverse localities; but that which is not sufficiently known, and even what is generally refused credit, is that each locality itself changes in time, exposure, climate, nature and quality, though so slowly in comparison with our lifetimes that we attribute to it perfect stability. Now, in one and the other case, these changed localities change correspondingly the relations to living bodies which inhabit them, bringing to bear new influences on them. It is known that when there are extremes in these changes there are gradations which are intermediate, and which fill the interval. Consequently there are shades of difference, which distinguish what we call species. It is therefore evident that the entire surface of the globe shows, in its nature and in the situation of the materials which occupy different localities, a diversity of circumstances which is everywhere in relation with that of the forms and of the parts of animals, independent of peculiar diver-

sity which necessarily results from the progress of the composition of the organization in each animal.

In every place where animals have been able to live, the circumstances which have established there an order of things which has continued for a long time the same, and change is there really so slow that man has not been able to observe it directly. He is obliged to consult records, and monuments, and to recognize that in each one of these localities the order of things which he finds there has not always been the same, and thus to infer that it will still change. The races of animals which live in any of these places must preserve their habits for a long time, hence to us the apparent constancy of races which we call species—constancy which has given us the idea that these races are therefore as ancient as nature.

But at different points on the surface of the globe which are habitable, the nature and situation of the localities and the climates constitute for animals, as for vegetables, different circumstances in all kinds of degrees. Animals which inhabit these different localities must then necessarily become different from each other, not only by reason of the state of growth of the organization in each case, but besides by reason of habits which individuals of each race are forced to adopt. Therefore, in a measure, in traveling over great portions of the surface of the earth, the observing naturalist sees circumstances change in a gradual manner; he perceives constantly also that the species change proportionally in their characters. Now, the true order of things, which is the question to consider in all this, consists in recognizing,—

1st. That every change, of any importance, in the circumstances in which each race of animals exists, continually maintained, effects a real change in their necessities.

2d. That all change in the wants of animals necessitates for them new actions, in order to satisfy new wants, and consequently other habits.

3d. That every new want necessitating new actions to satisfy it, requires from the animal which experiences it, more frequent employment of some of its parts of which it made less use before. Thereby are developed and enlarged considerably the new parts which the wants have insensibly created in it by the efforts of its

"interior sentiment." This is the question, as I will presently prove by known facts. To arrive at a knowledge of the true causes of so many diverse forms and so many different habits, of which known animals offer us examples, it is necessary to consider that the infinitely diversified circumstances, but slowly changing, which the animals of each race are continually encountering, produce for each of them new wants and necessarily changes in their habits. Now this incontestable truth once acknowledged, it will be easy to perceive how these new wants could be satisfied, and these new habits assumed, if we give some attention to the two following laws of nature, which observation has always proved to be constant:—

First Law.—In every animal which has not passed the time of its development the frequent and sustained employment of an organ gradually strengthens it, developes and enlarges it, and gives it power proportional to the duration of its use; whilst the constant disuse of a like organ weakens it, insensibly deteriorates it, progressively reduces its functions, and finally causes it to disappear.

Second Law.—All that nature acquires or loses in individuals by the influence of circumstances to which the race has been exposed for a long time, and in consequence by the influence of the predominate employment of such organ, or by the influence of disuse of such part, she preserves by generation, among new individuals which spring from it, providing the acquired changes be common to both sexes, or to those which have produced new individuals.

These are, then, two constant truths which cannot be misconstrued, except by those who have never observed or followed nature in her operations, or by those who entertain an error which I will combat. Naturalists having remarked that the forms of the parts of animals are always perfectly in harmony with the use of those parts, have thought that the forms and the conditions of the parts had caused their employment. Now this is an error, for it is easy to demonstrate by observation that on the contrary it is the wants and uses of the parts which have developed these same parts, that they are made to exist where they did not, and that consequently they have given place to the condition in which we observe them in every animal.

For, had this not been so, it would be necessary that nature

should have created for the parts of the animal as many forms as the diversity of the circumstances in which they had to live would have required, and that these forms as these circumstances should never have varied. This is certainly not the order of things which exists, and if it were really such we would not have the race-horses of the form of those in England. We would not have great draught-horses, so heavy and so different from the former. For had not nature herself produced the like, we would not have, for the same reason, lapdogs with slender limbs, greyhounds so agile in running, water-dogs, etc. We would not have poultry without tails, peacocks, pigeons, etc.; finally we would not be able to cultivate wild plants, as we please, in the rich and fertile soil of our gardens, without fearing to see them change by long culture. For a long time there has been in this respect a sentiment which has established the following saying, which has passed into a proverb, which all the world knows, that "habits form a second nature." Surely if the habits and the nature of each animal never varied, the proverb would have been false, and would not have been used for the cases to which it had been applied.

If people considered seriously all that I have just shown, they would know that I was well grounded in reasons when, in my work entitled "Recherches sur les corps vivans," p. 50, I established the following proposition: "It is not the organ, that is to say, the nature and form of the parts of the body of an animal which have given origin to its habits and peculiar functions, but it is, on the contrary, its habits, its manner of life and the circumstances in which individuals from which it came, found themselves, which have after a time constituted the form of its body, the number and character of its organs, and finally the functions which it possesses. Let us weigh well this proposition, and give to it all the attention which nature and the condition of things continually gives us opportunity. Then its importance and its truth will become perfectly clear.

Time and favorable circumstances being, as I have already said, the two principal means which nature employs in giving existence to all her productions, it is evident that time has no limit for her, and in consequence she has it always at her disposal. Concerning these circumstances, which she requires, and which she still uses

every day, to change all that which she continues to produce, they are in many ways inexhaustible to her. The principal proceed from the influence of climates, from that of diverse temperatures of atmosphere, and of all the surrounding media; that of the diversity of places, and of their situation; that of habits, of the most ordinary movements, of the most frequent actions; finally, of that of the means of self-preservation, of manner of life, of defence, of multiplication, etc. Now, by continuance of these diverse influences the faculties become expanded and strengthened by use, become diversified by new habits long maintained, and insensibly the conformation, consistence, in a word, the nature and condition of parts, also that of organs, participate in all these influences, maintaining and propagating themselves by generation.

These truths, which are only the result of the two natural laws expounded above, are in all cases strictly confirmed by facts; they indicate clearly the progress of nature in the diversity of her productions. But in place of contenting ourselves with generalities which may be considered as hypothetical, let us examine strictly the facts, and consider, in animals, the result of the use or disuse of their organs upon these organs themselves. According to the habits which each race has been forced to contract, I will prove that the constant lack of exercise, as regards an organ, diminishes at first its functions, gradually impoverishes it, and in the end makes it disappear, or annihilates it; so this disuse perpetuates itself for a long time thereafter in successive generations of animals of the same race. Afterwards I will show that, on the contrary, the habitual exercise of an organ in any animal which has not experienced a diminution of its functions, not only perfects and increases its functions, but otherwise makes it acquire the development and dimensions which insensibly change it, so that after a time it renders it different from the corresponding organ of another animal which exercises it much less.

The disuse of an organ having resulted in the habits which it has assumed, gradually impoverishes the organ, and finally makes it disappear, or obliterates it. As such a proposition could be admitted only on proof, and not on simple declaration, we will attempt to make it evident by the citation of known facts which constitutes its basis.

Vertebrate animals, of which the plan of organization is nearly the same, although they show much diversity in their parts, have, usually, their jaws armed with teeth. Nevertheless those among them which circumstances have given the habit of swallowing their food without previous mastication have been found to display a repressed development of these parts—that these teeth have even remained hidden between the osseous plates of the jaws without being able to appear, or all traces of them have entirely disappeared. Among whales, which people have believed completely deprived of teeth, M. Geoffroy has found them hidden in the jaws of the fœtus. This professor has also found in birds the groove where teeth should have been placed, but nothing more has been seen. In the class Mammalia, which embraces the most perfect animals, and principally those of which the plan of organization of the vertebræ is most completely executed, not only the whale has no teeth for its use, but one finds also in the same condition the ant-eater (Myrmecophaga), in which the habit of not masticating its food has been introduced and preserved for a long time in its race Eyes in the head is the rule for a great number of diverse animals, and are essential to the plan of the organization of vertebrates. Nevertheless the mole, which by its habits has very little occasion to see, has only very small eyes, and which scarcely show, because it exercises this organ very little.

"The Spalax d'Olivier" (Voyage en Egypt et en Persia, II., pl. 82, f. 2), which lives under ground like a mole, and which is probably less exposed to the light of day, and has totally lost the function of sight, shows scarcely the rudiments of the organ which is its seat, and these vestiges are entirely hidden under the skin and under whatever other parts which cover it, which allow no access of light. The Proteus, an aquatic reptile, cousin of the salamander, by all accounts lives in deep and obscure caverns, which are under ground, has, like the Spalax, only the traces of the organ of sight, which are covered and hidden in the same manner. Behold one decisive consideration relative to the question which I now discuss. Light does not penetrate everywhere, consequently animals which live habitually in those places where it does not come, lack occasion to exercise the organ of sight, if nature has provided them with it. Now, animals which partake in a plan of organization

in which eyes necessarily enter, must have originally had them. And, since one finds among them species which are deprived of these organs, and which have only traces, hidden and covered, it becomes evident that the impoverishment and even the disappearance of the organ in question is the result of constant disuse.

[To be continued.]

ON THE GLACIAL DRIFT AND LOESS OF A PORTION OF THE NORTHERN-CENTRAL BASIN OF IOWA.

BY CLEMENT L. WEBSTER.

THE region under consideration may include Floyd county, and portions of Cerro Gordo, Worth, Mitchell, Chickasaw, Bremer, Butler, and Black Hawk counties. The general topography of this region is that of a gently undulating prairie country, with often a more or less broken surface along the course of the streams. Portions of Worth, Chickasaw and Bremer counties are low and rather wet, while that of other portions of the area are dryer and more rolling. The western portion of this region is drained mainly by Flood and Lime creeks and the Shellrock river, while the eastern portion is drained by the Cedar and Wapsipinecan rivers and their affluents.

All the streams of the area have a general northwest and southeast trend; their initial direction having been predetermined by the general dip of the subjacent rock strata. The Shellrock and Lime creeks have, for the most part, in their course through this region, eroded their channels through the drift, and into the underlying Devonian strata to a depth varying from five to seventy feet. The Cedar has cut through the drift, and sunk into the underlying rocks to a depth of from ten feet to over one hundred feet. The Wapsipinecan river and Flood creek flow through this country mostly upon the drift formation. The valleys

of the streams of this area are usually broad, with one side more or less well defined, while the opposite side gradually emerges into the adjoining upland.

By far the greater portion of the surface of the area is occupied by the drift formation, which varies much in thickness at different localities. The difference seems to be partially due to original deposition, and partially to subsequent erosion. A line drawn from Waterloo, in Black Hawk county, in a northwest direction to Mason City, in Cerro Gordo county, and another line drawn from Waterloo to Osage, in Mitchell county, would include within their boundary the area of the thinnest drift of the region, and, indeed, of Iowa. In all parts of this attenuated drift area, the underlying rock strata is exposed at the surface in very numerous places.

Present evidence seems to indicate that the superficial geological formation of this entire region shows two main Glacial epochs, each of which is characterized by several subdivisions. As belonging to the earlier Glacial epoch, there are recognized two drift sheets. Between these occur, at numerous points in the area, and other portions of the State, vegetal accumulations, indicating a non-glacial interval. This horizon is usually referred to as the "Old Forest Bed." The material of the lower and upper drift sheets is (so far as observed) essentially the same, being composed for the most part of a heavy, dark blue clay, containing a greater or less number of transported deangulated erratics and pebbles, numbers of them being in a partially decomposed condition. At some points the clay of these beds is distinctly stratified, and as readily separated into layers as ordinary limestone.

The vegetal accumulation which occupies a horizon between these drift sheets is composed of coniferous wood, branches and twigs, which is very often associated with ancient peat, and more or less mixed with the drift. In digging wells in this division, natural gas is often obtained,[1] this originating from the organic accumulation. Gathering evidence seems to demonstrate that the vegetal accumulation of this region, as well as that of some other places in the State, are referable to a single horizon.

[1] In an article on "The Geology of Johnson county, Iowa," which appeared in the May number of this Journal for 1888, mention was made, by the writer, of wells of this character in Linn county, Iowa.

As belonging to the later Glacial epoch, we recognize three divisions: the Upland, or (for the most part) unstratified drift; Valley, or stratified drift; and Loess. The Upland drift constitutes by far the greater bulk of the superficial covering of the region. Its material is mainly true till, with local deposits or pockets of coarse gravel and sand, which is sometimes slightly cemented together by calcareous cement, and large numbers of transported erratics. There also occur local deposits of stiff red clay; for example, near Floyd, Nora Springs, and Rockford, in Floyd county.

These deposits of clay are usually quite free from erratics, gravel or sand, has a soapy feel, and becomes very hard upon short exposure to the atmosphere. The gravel deposits of this division are not restricted to any definite horizon, but are irregularly distributed through it. The material is usually well rounded pebbles of several varieties of greenstone, quartz (much of it probably of Cretaceous origin), granite, Devonian limestone, jasper, etc. There also sometimes occur specimens of coal, native copper and iron,[1] as well as Devonian and Trenton fossils. Large numbers of deangulated granite and greenstone boulders, and more rarely those of quartz, are seen distributed over the surface and mixed with the till. The boulders vary in weight from two pounds to ten or twenty tons: of the latter, fine examples are observed near Portland, Osage, Nashua, and other places.

In some parts of the area, angular fragments of Cretaceous conglomerate are not uncommon in the drift. This material was probably derived, at least in part, from the southwest portion of Floyd county, where rocks of this age are known to occur in place.[2] The material of this division is usually unstratified, but at times it is observed to be obliquely and discordantly stratified at high points, distant from waterways.

The region of most numerous erratics is that of the eastern portion of the area. A strip of country from one-half to four miles in width is occupied by great numbers of boulders, mostly of granite and green-

[1] The occurrence of these ores, etc., in the drift of this region, was noted by the writer in a paper on "The Glacial Flow in Iowa," which appeared in the August number of this Journal for 1887.

[2] A description of this rock has been given by us in a paper on "A Description of the Rockford Shales of Iowa," which appears in Vol. VI. of the Proceedings of the Davenport Academy of Science.

stone. This boulder line has been traced by us from a point about one mile northeast from Charles City, in Floyd county, to a little east of Waterloo, a distance of about fifty miles. Below this point we have not traced it; neither have personal observations of it been made beyond Charles City. It has been reported to me, however, that from Charles City the boulder line extends in an easterly direction to a point near Fort Atkinson, in Winneshiek county, and there turns and pursues a more northerly course. From Charles City this boulder line takes a general southeast course, passing about two miles east of Nashua, in Chickasaw county, where it attains its greatest observed width, four miles. From this point it assumes a somewhat more easterly direction, and gradually diminishes in width. At a point midway between Richland Centre and Frederica, it again turns and pursues a more southerly course to Waterloo; the direction corresponding in the main with the general trend of the Wapsipinecan and Cedar rivers. In some localities, for example, Richland Centre, Frederica, etc., breaks in this line occur, from one-fourth to one-half mile in extent, where the erratics are relatively rare, but which soon appear again in strong force.[1] An interesting and instructive feature of these boulders is, that they are all (so far as noticed) deangulated, smooth, and very hard, while large numbers of them are flattened and striated on one side by glacial action. This feature is shared in to no such extent by the erratics of other portions of the area. The second recognized division of the later Glacial epoch is the Valley, or stratified drift. Of the river valleys of this region, only one is known to contain true Valley drift; and this the valley of the Shellrock.

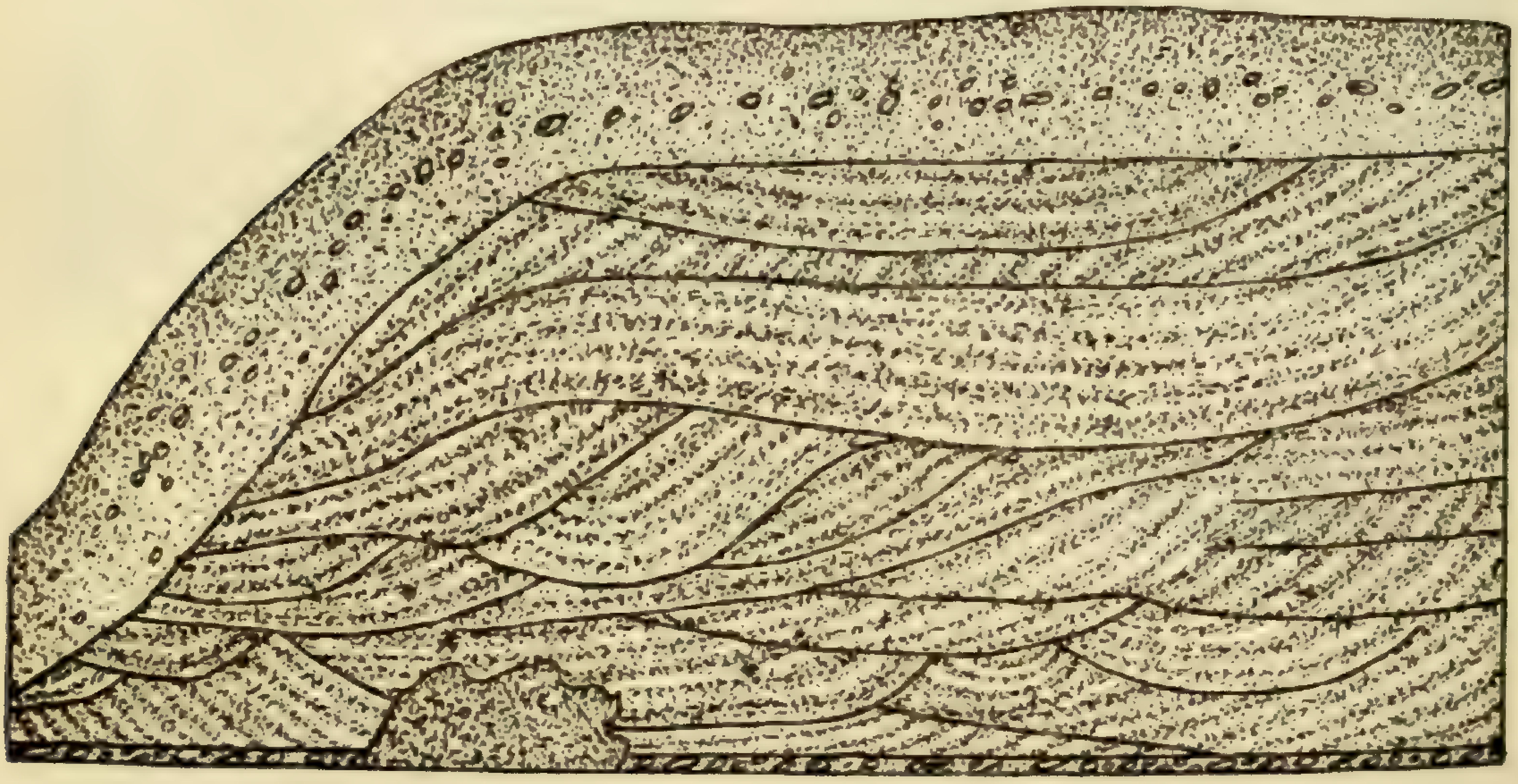
Although at different places along the course of some of the streams, local deposits of more or less distinctly stratified drift occur, still, as a rule, this feature is no more pronounced than at some points in the Upland drift. The Shellrock heads near Lake Albert Lea, Minnesota, and flows into this sheet of water at its upper extremity, and makes its exit at its lower o! southern extremity. This sheet of water occupies a depression in the Inter-lobular moraine which enters Iowa. The Shellrock flows upon this heterogeneous drift accumulation for a distance of ten miles, and

[1] Owing to the lack of other rock here for building purposes, the boulders are extensively used for underpinning, well and cellar walls, bridge piers, etc., for which they answer a most excellent purpose.

in reality does not reach the subjacent rock strata (except at two or three points) until Plymouth, in Cerro Gordo county, Iowa, is reached. From this point to its confluence with the Cedar, fifty-seven miles below, it has eroded its channel down through the drift formation, and flows upon the underlying Devonian strata.

Stretching away from the morainic border, and partially filling the valley of the Shellrock, is a train of Valley drift, which extends to the confluence of this stream with the Cedar, seventy-two miles below. This morainic border lies upon rolling country, and there leads away from it, in portions of Cerro Gordo and Worth counties, valleys or trough-shaped depressions of notable size, which we should naturally expect would have drawn very considerable drainage floods from the margin of the ice. The material of this formation is usually well rounded, coarse and fine gravel and silicious sand, not essentially differing from the Upland drift gravel, except that it contains a very much larger percent-

FIG. 1.



age of silicious sand, and does not usually contain any perceptible admixture of clay. The material (except the very coarse portion) is everywhere obliquely and discordantly stratified. This feature is well illustrated in the following sections.

Fig. 1 represents a section of Valley drift at Rockford, illustrating the flow and plunge style of stratification. The material is mostly fine

silicious sand, with a layer of coarse rounded gravel at the bottom, resting upon Devonian strata. The upper bed is a fine silt-like soil, mixed with coarse drift gravel, due in part to secondary accumulation arising from wash from a slight adjoining slope. The talus of sand at the base conceals several subordinate beds.

FIG. 2.

Fig. 2 represents a section of Valley drift near Nora Springs, illustrating oblique stratification. The material is well rounded gravel and sand. The upper bed is a black homogeneous silt, containing a few small drift pebbles. The second bed is a yellow clayey soil, with some fine gravel in the lower portion.[1] The next succeeding bed is partially stratified gravel and sand. The wave-like parts of Figure 1 correspond to succeeding plunges in the rapidly flowing waters, and indicates a much more turbulent condition of the water than when the material of Figure 2 was deposited.

At Clarksville, in Butler county, and other places, the Valley drift is seen to be obliquely stratified, the same as near Nora Springs. The gravel of this division at different points has been more or less solidified by calcareous cement. An interesting feature of this formation is that very often a large percentage of the finer material occupies the lowest position. while the coarser material often occupies the higher position.

Fine examples of terraces are observed along the streams of this region; for example, on the west side of the Cedar, a few miles above Waverly; on the west side of the Shellrock, two

[1] These beds well illustrate the condition of the first few feet of the superficial accumulation of nearly all parts of the area under consideration.

and one-half miles northwest from Rockford; on the east and west sides of Linn creek, one and one-half miles west of Rockford, and other places. These terraces appear to have been formed by the contracting and deepening of the channels of these streams by their own waters.

The last recognized division of the later Glacial epoch is the Loess formation. This formation is represented by only a few limited outliers at different points along the course of the Cedar river. On the west side of the Cedar, at Mitchell, in Mitchell county, is a local deposit of very fine and homogeneous, typical yellow loess, having a thickness of twelve feet. This rests directly upon a layer (from four to six inches in thickness) of clean rounded and angular drift pebbles, and the pebbles in turn rest (in places) upon a very dark, ferruginous layer of rock, which lays upon broken-up Devonian limestone below.

In the lower portion of the exposure of loess, one or two large shells was found, which were, however, in a too imperfect state of preservation for satisfactory determination. On the east side of the Cedar, one mile above Floyd, another outlier of this formation occurs. The loess at this place is like that observed at Mitchell, except that it contains small quantities of silicious sand in places, and in places has a very slight blueish-gray shade. The greatest observed thickness of this exposure was, by estimate, twenty-one feet. No drift was seen to intervene between the loess and the coarse-grained calcareo-silicious sandstone below.[1] The surface of the rock at this place rises to a height of over one hundred feet above the water in the Cedar.

The locality where this formation is next observed is on the same stream, at Waverley, about thirty-two miles below Floyd. The loess here (so far as ascertained) is light yellow, fine-grained and homogeneous, but contains at one point a very large amount of dark, grayish-brown silicious sand. No fossils, concretions, or ferruginous tubules was noticed in the loess of this place.

Probably no department of geological investigation has greater

[1] This sandstone attains a thickness of two feet, and rests upon very hard and fine-grained, grayish-white Devonian limestone. No sandstone exactly like this is known to occur at any other point in northern Iowa.

need of careful criticism than that which deals with the complex deposits of the Glacial period. Nowhere, perhaps, is there need of closer examination, and nowhere, probably, is the discrimination more difficult than in drawing the line between the earlier Glacial epoch and the later Glacial epoch of the area which has been under consideration.

HISTORY OF GARDEN VEGETABLES.

BY E. LEWIS STURTEVANT, M.D.

(Continued from page 808.)

Kohl-rabi. *Brassica oleracea caulo-rapa*, D C.

I FIND no certain identification of this race in the ancient writings. The *bunidia* of Pliny[1] seems rather to be the ruta baga, as he says it is between a *radish* and a *rape*. The *goggulis* of Theophrastus[2] and Galen[3] seems also to be the rutabaga, for Galen says the root contained *within* the earth is hard, unless cooked. In 1558 Matthiolus[4] speaks of the kohl-rabi as having lately came into Germany from Italy. Between 1573 and 1575 Rauwolf[5] saw it in the gardens of Tripoli and Aleppo. Lobel[6] in 1570, Camerarius[7] in 1586, Dalechamp[8] in 1587, and other of the older botanists, all figure or describe it as under European culture. This plant, in the view of some writers, is a cross between the cabbage and the rape, and many of the names applied to it convey this idea. This view is probably a mistaken one, as the plant in its sportings under culture tends to the form of the marrow cabbage, from which it is probably a derivation. In 1884, in two plants in pots in the

[1] Pliny. Lib. xx., c. 2.
[2] Theophrastus. Lib. vii., c. 4.
[3] Galen. De Alim.
[4] Matthiolus Comm., 1558, 248.
[5] Gronovius. Orient., 81.
[6] Pena and Lobel. Adv., 1570, 92.
[7] Camerarius. Epit., 1586, 251.
[8] Hist. Gen. Lugd., 1587, 522.

green-house, I had good kohl-rabi bulbs, and one of these extended itself until it became a marrow cabbage, and when planted out in the spring attained its growth as a marrow cabbage. This idea of its origin finds countenance in the figures of the older botanists; thus Camerarius, in 1586, figures a plant as a kohl rabi which in all essential points resembles a marrow cabbage, being tapering from a small stem into a long kohl rabi, with a flat top like the marrow cabbage. The figures given by Lobel,[1] in 1591, Dodonæus,[2] in 1616, and Bodæus,[3] in 1644, when compared with Camerarius' figure, suggest the marrow cabbage. A long highly improved form, not now under culture, is figured by Gerarde,[4] in 1597, J. Bauhin,[5] in 1651, and Chabræus,[6] in 1677, and the modern form is given by Gerarde, and by Matthiolus[7] in 1598. A very unimproved form, out of harmony with the other figures, is given by Dalechamp,[8] in 1587, and Castor Durante,[9] in 1617.

This synonymy can be tabulated in order as below:—

1. Caulorapum. Cam. epit., 1586, 251.

2. { Rapa, Br. peregrina, caule rapum gerens. Lob. ic., 1591, 246.
Br. caule rapum gerens. Dod. pempt., 1616, 625.
Rapa brassica. Bodæus, 1644, 777.

3. { Caulo rapum longum. Ger., 1597, 250.
Br. caulorapa. J. Bauh., 1651, ii., 830.
Br. caulorapa sive Rapo caulis. Chabr., 1677, 270.

4. { Caulorapum rotundum. Ger., 1597, 250.
Brassica gongylodes. Matth. op., 1598, 367.

5. { Brassica raposa. Lugd., 1587, 522.
Bradica raposa. Cast. Dur., 1617, app.

Matthiolus, as we have stated, says the plant came into Germany from Italy; Pena and Lobel say it came from Greece; Gerarde, that it groweth in Italy, Spain and Germany, from whence he

[1] Lobel. Ic., 1591, 246.
[2] Dodonæus. Pempt., 1616, 625.
[3] Bodæus a Stapel. Theophrastus, 1644, 777.
[4] Gerarde. Herb., 1597, 250.
[5] J. Bauhin. Hist., 1651, ii., 830.
[6] Chabræus. Ic. et Sci. ag. 1677, 270.
[7] Matthiolus. Op., 1598, 367.
[8] Castor Durante. Herb., 1617, app.
[9] Fessenden. New Am. Gard., 1828, 59.

received seeds. These excerpts indicate a southern origin for this vegetable, and the marrow cabbages are very sensitive to cold. The more highly improved forms, as figured in our synonymy, are in authors of northern or central Europe, while the unimproved forms are given by more southern writers. This indicates that the present kohl rabi received its development in northern countries.

The varieties now grown are the white and purple, in early and late forms, the curled leaf, or Neapolitan, and the artichoke-leaved. One, at least, was in American gardens as early as 1806, and the rest appear before 1863.

The nomenclature of this plant is deserving of attention, from the presence of foreign words, for which its history seems to afford but little justification.

The *kohl-rabi, Turnip-rooted cabbage, Arabian, cole rape, cole turnip, Cape cabbage,*[1] or *Hungarian turnip,* is called in France *choux-raves, chou de Siam, boule de Siam;* in Germany, *oberkohlrabi;* in Flanders, *raapkool;* in Holland, *koolraapen boven den grond;* in Denmark, *overjordisk kahlrabi, kundekaal;* in Italy, *cavolo rapa, torsi;* in Spain, *col rabanho;* in Portugal, *couve rabano, couve de Siam;*[2] in Norway, *overjords-kaalrabi;*[3] in India, *ole kole,* or *gool jur ka kuhun.*[4]

Lavender. *Lavandula vera* D C.

Lavender is sometimes grown for the use of the leaves as a condiment, but more often for the flowers, which find use in perfumery; but we have never heard of its being grown on a large scale in the United States, although it was in garden culture in 1806. Its present growing is doubtless very insignificant.

There is no satisfactory identification of lavender in the writings of the ancients, although it seems to have been well known to the botanists of the sixteenth century, and the use of the perfume was indicated as early as the fourteenth century, and as a medicine even in the twelfth century.[6] Its seed was in English seedsmen's lists of 1726,[7] for garden culture.

[1] Townsend, seedsman, 1726, 28.
[2] Dodonæus. Gard. Dict., 1831, i., 228.
[3] Vilmorin. Les Pl. Pot., 1883, 139.
[4] Schubeler. Culturp. f. de Norw., 105.
[5] Speede. Ind. Handb. of Gard., 1842, 140.
[6] See Pharmacographia, 1879, 476.
[7] Townsend, seedsman, 1726, 37.

Lavender is called in France *lavande, aspic, lavande femelle;* in Germany, *lavendel, spike;* in Flanders, *lavendel;* in Denmark, *lavendel;* in Italy, *lavanda;* in Spain, *espliego.*[1]

Lavandula spica L., a more southern species, is confounded with the above in cultivation, and is also cultivated on a large scale for purposes of distillation. Mawe, in 1778, named four varieties, the narrow-leaved with blue flowers, the narrow-leaved with white flowers, the broad-leaved and the Dwarf.

Leek. *Allium porrum* L.

This vegetable was the *prason* of the ancient Greeks, the *porrum* of the Romans, who distinguished two kinds, the *capitatum,* or leek, and the *sectilis,* or chives, perhaps, although Columella,[2] Pliny[3] and Palladius[4] indicate these as forms of the same plant brought about through difference of culture, the chive-like form being produced by thick planting. They seem to have been very popular at Rome. In Europe the leek was generally known throughout the middle ages, and in the earlier botanies some of the figures of the leek represent the two kinds of planting alluded to by the Roman writers. In England, in 1726, Townsend[5] says that "leeks are mightily used in the kitchen for broths and sauces." When they reached America I do not find recorded, but prior to 1775 they were grown at Mobile, Ala., and were cultivated by the Choctaw Indians.[6]

The leek may vary considerably by culture, and often attains quite a large size; one with the blanched portion a foot long and nine inches in circumference, and the leaf fifteen inches in breadth and three feet in length, has been recorded.[7] Vilmorin[8] described eight varieties in 1883, but some of these are scarcely distinct.

The *leek,* or *porret,*[9] is called in France *poireau, poiree, poirette, porreau;* in Flanders and Holland, *prei;* in Germany, *lauch, por-*

[1] Vilmorin. Les Pl. Pot., 1883, 318.
[2] Columella. Lib. ii., c. 8.
[3] Pliny. Lib. xix., c. 34.
[4] Palladius. Lib. iii., c. 24.
[5] Townsend. 1726, 37.
[6] Romans. Nat. Hist. of Fla., i., 115. 84.
[7] Gard. Chron., Nov. 6, 1886, 599.
[8] Les Pl. Pot., 1883, 416.
[9] Ray. Hist., 1688, 1126.

ree; in Denmark, *porre;* in Italy, *porro;* in Spain, *puerro;* in Portugal, *alho porro;* in Greece, *to prasa;* in Sweden, *puris;*[1] in Russia, *pras;*[2] in Norway, *purre.*[3] In Arabic, *karrat,*[4] or *kournas;* in Bengali, *puroo;* in Egypt, *korrat;*[5] in India, *kundaneh, zalook* or *puroo;*[6] in Persian, *gundena.*[5]

This species is supposed by authors to be a cultivated form of *Allium ampeloprasum* L.

Lentil. *Ervum lens* L.

The cultivation of the Lentil is very ancient, as it has been found in the Egyptian tombs of the twelfth dynasty, or 2,200 to 2,400 B.C.[7] It has also been found in the lacustrine debris of Switzerland dating from the age of bronze.[8] Its culture was well known to the ancient Greeks and Romans, and has been continued through the middle ages to the present time. Bauhin,[9] in 1623, names a large and a small sort, the seed reddish, pale yellow, white, tawny and black, and Vilmorin,[10] in 1883, describes four varieties for garden culture. Its seed is used in soups and stews, and the culture is of more importance in the warmer regions. Lentils are recorded by Burr,[11] in 1863, for American use; but much of the seed found exposed for sale in groceries is imported.

The *lentil* is called in France *lentille, arousse, aroufle;* in Germany, *linse;* in Flanders and Holland, *linze;* in Denmark, *lindse;* in Italy, *lente, lenticchia;* in Spain, *lenteja;* in Portugal, *lentilha.*[10] In Arabic, *a'ds;*[12] in Egypt, *adz;* in India, *mussoor;* in Sanscrit, *mussoora;*[13] in Latin, *lens;* in Slav, *lesha;* in Illyrian, *lechja;* in Lithuanian, *lenszic;* the Greeks, *fakos* or *fakai;* the Berbers, *ades.*[8]

[1] Decandolle. Geog. Bot., 848.
[2] McIntosh. Book of the Gard., ii., 47.
[3] Schubeler. Cult. Pflanz den Norw., 53.
[4] Delile. Fl. Æg. Ill.
[5] Birdwood. Veg. Prod. of Bomb., 186.
[6] Speede. Ind. Handb. of Gard., 158.
[7] Schweinfurth. Nature, Jan. 31, 1883, 314.
[8] Decandolle. Orig. des Pl. Cult., 258.
[9] Bauhin. Pin., 1623, 346.
[10] Vilmorin. Les Pl. Pot., 318.
[11] Burr. Field and Gard. Veg., 1863.
[12] Delile. Fl. Ægypt. Illust.
[13] Birdwood. Veg. Prod. of Bomb., 119.

Lettuce. *Lactuca sativa* L.

This, the best of all salad plants, as a culivated plant has a high antiquity. It is evident, by an anecdote related by Herodotus, that it appeared at the royal tables of the Persian kings about 550 B.C.[1] The medicinal properties as a food-plant was noted by Hippocrates,[2] 430 B.C., praised by Aristotles,[3] 356 B.C., and the species described by Theophrastus,[4] 322 B.C., Dioscorides,[5] 60 A.D., and mentioned by Galen,[6] 164 A.D., who gives an idea of a very general use. Among the Romans it was very popular. Columella,[7] A.D. 42, describes the Cæcilian, Cappadocian, Cyprian and Tartesan. Pliny,[8] A.D. 79, enumerates the alba, Cæcilian, Cappadocian, crispa, Græca, Laconicon, nigra, purpurea and rubens. Palladius,[9] 210 A.D., implies varieties, and mentions the process of blanching. Martial,[10] A.D. 101, gives to the lettuces of Cappadocia the term *viles*, or cheap, implying abundance. In China its presence can be identified in the fifth century.[11] In England, Chaucer, about 1340, uses the word in his prologue, "well loved he garlic, onions and lettics," and it is likewise mentioned by Turner,[12] in 1538, who spells the word *lettuse*. It is mentioned as cultivated in Isabella Island, in 1494, by Peter Martyr,[13] as also in Mexico at a later date; is noted as abundant in Hayti in 1565,[14] etc.

In the report of the New York Agricultural Experiment Station for 1885, eighty-seven varieties are fully described with 585 names or synonyms. Vilmorin[15] describes, in 1883, one hundred and thirteen kinds as distinct. The number of varieties named by various writers at various times are as follows: For France, in

[1] McIntosh. Book of the Gard., ii., 5.
Hippocrates, Cornarius ed., Paris, 1546, 113.
[3] Scaliger. De Plant.; Arist., 1566, 63, etc.
[4] Theophrastus, Bodæns ed., 1644, 761.
[5] Dioscorides, Vergelius ed., 1532, 220; Ruellius ed., 1529, 130.
[6] Galen. De Alim., lib. ii.; Gregorius ed., 1547, 143.
[7] Columella, lib. x., c. 181–193, 369.
[8] Pliny, lib. xix., c. 38.
[9] Palladius, lib. ii., c. 14; lib. iii., c. 24; lib. iv., c. 9, etc.
[10] Martial, lib. v., 79.
[11] Bretschneider. Bot. Sin., 78.
[12] Turner. Libellus, 1538.
[13] Edens Hist. of Trav., 1577.
[14] Benzoni. Hist. of the New World, Smythe ed., 1857.
[15] Vilmorin. Les Pl. Pot., 1883.

1612, six; in 1690, twenty-one; in 1829, forty; in 1883, one hundred and thirteen. For Holland, in 1720, forty-seven. For England, in 1597, six; in 1629, nine; in 1726, nine; in 1763, fifteen; in 1765, eighteen; in 1807, fourteen. In America, in 1806, sixteen; in 1885, eighty-seven.

The cabbage and cos lettuces are the sorts now principally grown, but various other kinds, such as the curled, are frequently, and the sharp-leaved, oak-leaved, etc., occasionally, as novelties.

In this large class, I shall content myself with offering the synonymy of a few of the varieties now known, and which shall indicate the antiquity of our cultivated types.

I. The Lanceolate-leaved Type.

Lactuca longifolia. Bauh. phytopin., 1596, 200.
Lattuga franzese. Cast. Dur., 1617, 244, cum ic.
Lactuca folio oblongo acuto. Bauh. pin., 1623, 125; prod., 1671, 60, cum ic.
Lactuca longo at valde angusto folio. J. Bauh., 1651, ii., 999, cum ic.; Chabr., 1677, 313, cum ic.
Deer Tongue. Greg., 1883.

II. The Cos Type.

Pena and Lobel,[1] in 1570, say that this form is but rarely grown in France and Germany, although common in the gardens of Italy; and Heuze[2] says it was brought from Rome to France by Rabelais in 1537.

Lactura florescens. Cam. epit., 1586, 299, cum ic.
Lactuca intybacea, Lombard Lettuce. Ger., 1597, 240, cum ic.
Lactuca foliis endiviæ. Matth. op., 1598, 399, cum ic.
Lactuca Romana longa dulcis. J. Bauh., 1651, ii., 998, cum ic.; Chabr., 1677, 313, cum ic.
La Romaine. Le Jard. Solit., 1612.
Romaines. Vil,, 1883, 307.

We can reasonably believe the lettuce of Camerarius to be very close to the Florence Cos. The Lombard lettuce was grown as a sport in the garden of the New York Agricultural Experiment Station, in 1886, and the figures by Bauhin and Chabræus may well be the Paris Cos. I would not be understood, however, as imply-

[1] Pena and Lobel. Adv., 1570, 90.
[2] Heuze. Les Pl. Alim., i., v.

ing that these figures represent the improved forms of our present culture, but as the prototypes from which our plants have appeared, as shown not only by resemblance of leaf form, but through the study of variables in the garden. Ray, in 1686, describes the Cos as having light green and dark green varieties, and these, as well as the Spotted Cos, are indicated by Bauhin in 1623.

III. The Headed Lettuce.

This is the sort commonly grown, and the figures given in the sixteenth century indicate that the heading habit was even then firmly established. We have the following synonyms to offer, premising that types are referred to, and not exact variety resemblance:—

a.

Lactuca crispa. Matth., 1558, 264 ; Pin., 1561, 195.
Lattuga. Cast. Dur., 1617, 243.
La royale? Le Jard. Solit., 1612; Quintyne, 1690, etc.
Laitve Blonde de Berlin, syn. Laitve royale. Vil., 1883, 295.
Berlin.

b.

Lactuca sativa sessilis sive capitata. Lob. ic., 1591, i., 242.
Lactuca capitata. Dod., 1616, 645.
Very Early Dwarf Green.

c.

Lactuca. Cam. epit., 1586, 298.
Lactuca capitata. Ger., 1597, 240.
Lactuca crispa. Matth. op., 1598, 399.
Batavians. Vil., 1883.

d.

Lattich. Roszlin, 1550, 167.
Green Fringed.

This latter identification is from the appearance of the young plant. The old plant is remarkably different, forming a true rosette.

IV. Cutting and Miscellaneous.

a.

Lactuca crispa altera. Ger., 1597, 240.
Lactuca crispa et tenuiter dissecta. J. Bauh., 1651, ii., 1000; Chabr., 1677, 314.
Curled Cutting.

b.

Lactuca foliis querni. Ray, 1686, 219.
Oak-leaved.

c.

Capitatam cum pluribus capitibus. J. Bauh., 1651, ii., 998; Chabr., 1677, 313.
Egyptian Sprouting.

The minor variations which are now separated into varieties did not receive the same recognition in former times, the same variety name covering what now would be several varieties; thus Quintyne, in 1693, calls perpignans both a green and a pale form, etc. Green, light green, dark green, red and spotted lettuces are named in the old botanies; hence we cannot assert any new types have appeared in modern culture.

The generic names of the *lettuce* in the various languages are: in Greek, *thridakine, thridakinos, thridax hemeros;* in Latin, *Lactuca;*[1] in France, *laitue cultivee;* in Germany, *lattich;* in Flanders and Holland, *latouw;* in Denmark, *salat;* in Italy, *lattuga;* in Spain, *lechuga, ensiam;* in Portugal, *alface;*[2] in Sweden, Denmark and Russia, *laktuk;*[3] in Norway, *salat;*[4] in Arabic, *khass*[5] or *khus;*[6] in Ceylon, *salada;*[7] in China, *ye tsai, kiu,*[8] *sheng-tsai, paiku;*[9] in Cochin China, *rau, diep tau;*[8] in Egypt, *chaff;* in Hindustani, *kahoo;*[7] in India, *kahoo;*[10] in Japan, *kantats, futsu kusa, too tsisa.*[11]

[1] Grandsagne Pliny. Notes, xii., 354.
[2] Vilmorin. Les Pl. Pot., 285.
[3] Miller's Dict., 1807.
[4] Schubeler. Cult. Pfl. den Norw., 85.
[5] Delile. Fl. Æg. Ill.
[6] Wilkinson. Anc. Egypt, ii., 22.
[7] Birdwood. Veg. Prod. of Bomb., 49, 165.
[8] Loureiro. Fl. Cochinch., 479.
[9] Bretschneider. On the Study, etc., 17.
[10] Speede. Ind. Handb. of Gard., 166.
[11] Kæmpfer. Amœn., 1712, 831.

THE WESTERN SOCIETY OF NATURALISTS.[1]

BY S. A. FORBES.

THE first presidential address of a new society may well have for its subject the society itself; and the first duty of those responsible for such a society is to show its right to exist. There is only so much social power available for social purposes; why should we string a new belt to the already heavily burdened shaft, and tax the groaning engine with the movement of a new machine? Shall we interrupt and weaken the action of any existing agencies by this additional draft on the common stock of energy? or may we believe, on the contrary, that the final effect of our organization will be to increase the energy and activity of the whole apparatus; that it will react, in time, to supply power greater than that which it abstracts? In short, what are the objects and purposed uses of this Society of Western Naturalists? first, as to its own members; and second, as to society at large. These questions I shall endeavor to answer—not authoritatively—for only the Society can speak with authority for itself—but by way of interpretation and personal suggestion, hoping at least to raise questions concerning our scope, intention, and relations, which you may answer finally according to the common wish and judgment.

It seems proper, first, to say that in asking these questions, and in my attempts to answer them, I have in mind the present time, place, and conditions; that I shall not treat of the work which this Society might and should perform if it were established in Europe, or on the Atlantic seaboard, or if it were working in the twentieth century, but I shall inquire what are the ways in which we can most and best advance the study of our subjects in the present time and the immediate future, taking as our starting point the state of knowledge, the conditions of progress, and the special problems presenting themselves now in the northern half of the Mississippi valley.

And first, I remark, in phrase now temporarily classic, that "it is a condition and not a theory that confronts us." In the course

[1] Presidential address delivered at Champaign, Ill., October 24, 1888.

ot the development of science in this region, the easy things have in great part been done. The glittering sands have been largely passed through the cradle of the pioneer miner; the easily worked ores have been more or less thoroughly extracted, and we are fast approaching, if we have not already reached, the period when accumulated capital, powerful and complicated machinery, and the expert skill of the mining engineer are indispensable to the further development of our natural wealth. When a morning walk along the banks of the Wabash would give a Say new objects enough to keep him happily busy for weeks; when the moderately careful search of a single orchard or garden would yield to Fitch or Walsh, or the boyish Riley, material enough for an elaborate report; when the virgin soil of natural science only needed to be tickled with a hoe to laugh with a harvest, the question of methods and apparatus was one of quite subordinate importance. Little method and less machinery were needed to make a man useful and even eminent. And as for the educational problems with which we now have to deal, they gave the least imaginable concern, because they were practically non-existent. Until the movement for an industrial education based on science began, like a great ground swell, to heave the quiet surface, and until the tidal wave of popular interest and personal enthusiasm, set in motion by the elder Agassiz at Cambridge, swept across the West, the question of methods of instruction in natural history in school or college stood scarcely higher in the general estimation than that of the study of the language of the inhabitants of Mars. No one troubled himself about either. But since then, progress has been positive and really rapid, as those can best believe who have felt the full lift of the surge—has come with a speed accelerated, in fact, by the coincidence of three great movements.

First, the onward movement of the natural sciences themselves—a growth which is the continual astonishment of every intelligent observer, and the despair of all but the ablest and most active students.

Second, the movement of growth and development in this nterior region, relatively new, and newest of all in matters of science—this again a movement phenomenal in the history of the world.

And third, the progress resulting from the substitution of a younger and more highly educated working generation for an older one largely without special training.

From all this has come a recent change of status and surroundings, a modification of standards, a shifting of purposes and responsibilities, an accession of ideas, and a multiplication of duties, such as to compel us to consider the situation anew, and to urgently require a reorganization, along new lines, of whatever strength we can muster. In brief, the old machinery of scientific organization and development here in the West is much of it obsolete and inactive, and, taken as a whole, it is insufficient for the present day. The field of operation proposed by our Society—that of the improvement of methods of work, study, and instruction, is newly opened up to us by the rapid multiplication and complication of our subjects. The work we shall do is largely a new work, laid upon us as a condition of further symmetrical growth; and its performance is a duty which the promoters and curators of science and education in this region can avoid only at their own peril, and to the injury of the interests for which they have made themselves responsible.

If we look now to the benefits which we as individuals may hope to derive from our meetings, I count as most important some of those which are perhaps least obvious.

We are distinguished especially as a Society by an attention to methods rather than to results. That each worker should be deeply interested in whatever improvements of method are brought to light in his own field goes without saying, for in scientific research the method is, next to the man, the most important thing; the quality of the result depends on the choice of it, and the quantity upon that ready familiarity with it which makes every stroke tell to the best advantage; but if this were all, we should find ourselves splitting up into little sections of specialists, each indifferent to the other; or resolving ourselves, as an alternative, into a mutual toleration society, each group bearing patiently with the discussions of the others, that it might have the floor itself in turn. In fact, however, the methods of the different sciences are much more closely related than their results, and I am much mistaken if I, as a zoologist, shall not learn at least as much from the contributions to scientific method made by the botanists and geologists as from those

in my own field. I may care little for the classification of the Ustilagineæ, but the methods by which that classification were worked out may be of the greatest use to me in entomology. I had occasion at one time to study minutely a purely biological problem—that of the food preferences of certain families of beetles, about which too little was known, but found that I could do nothing with it except by the methods of the insect anatomist, on the one hand, and of the microscopist on the other. I need to know about the contagious diseases of insects, as a matter of practicable and biological entomology, but find myself powerless to investigate them until I become expert in the methods of the baceriologist and the cryptogamist generally, and until I can make the nicest of histological preparations. I would like to learn the life histories of some phytophagous insects, but by the time I have worked them out I shall have made a close practical acquaintance with several of the methods of botany and horticulture. A new piece of apparatus in the hands of the mineralogist will suggest to the botanist a device solving a difficulty which has long blocked his way in some tempting line of investigation. I wish now that some chemist would tell me how to distinguish spherical pigment granules, by chemical means, from micrococci. That item of chemical method would break down a barrier against which I have bumped my head in vain for a year.

And if this is so with methods of research, much more is it true of methods of instruction. The geologist has to do primarily with rocks and fossils, the botanist with plants, and the zoologist with animals; but teachers of whatever subject all have to do primarily and chiefly with the human mind and the training of it, and teachers of whatever natural science have special ends in view with respect to the training of mind not very widely different. If I shall be profited by knowing how the geologist does his work, much more shall I be pleased to learn how he leads his classes; and it is to be hoped that the discussions of teaching methods to which our meetings should give rise will result finally in the common acknowedgment and established use by all of us of certain principles and methods, such that our work may have a uniform character, and its results a definite value, not wholly dependent on the point of view and the personal idiosyncrasy of the instructor.

While our community of interests, this overlapping and intermingling of methods, brings us into closer fellowship than if this were an academy of sciences merely, so the motive that induces us must give our meetings an air of cordiality, of mutual gratitude, and good will. He who reads me a paper embodying results of research—the finished product of his work—may do it for my benefit, or possibly for his own—it sometimes takes evidence to determine which; but he who takes me into his shop, and shows me just how and with what he works, exposes to me the skilled methods which have yielded the results I admire and emulate, does that for *me*, there is no doubt about it.

We may be sure that the contributors to our programmes will be governed by a generous wish to share with each other the most precious items of their knowledge, those on which they especially depend for their own professional success.

Then we shall profit greatly, beyond a doubt, by the knowledge gained of the state and progress of science and education in our midst, as we hold our successive meetings in the various centres of education and research throughout our territory; and thus we shall learn what is the best thing which we as a Society can do for science in this region, and in each part of this region, from year to year, and shall be prepared always to welcome intelligently, and readily to assimilate the new energies penetrating to our midst—avoiding, on the one hand, that attitude of selfish and obstinate conservatism, which, acting on the unprincipled motto, "After us the deluge," would sweep back the future with its burden of progress; and, on the other hand, rapidly, but genially, toning down the crude and intolerant egotism of the occasional brand new man, who thinks to himself, "Before me chaos." And so we shall hold, I hope, to the golden mean of vigorous and rapid, but continuous and harmonious, growth.

But the scientist is also a citizen, and all the more a citizen the more a scientist he is, if he knows his own interest and duty. His social responsibilities, like those of all other men, increase with his capacity, with his possible importance as a factor in the social scheme; and he has a special social interest due to the fact that the higher the grade of his work, the more important to him, the more nearly indispensable, indeed, is a high grade of social organization

about him—a fine and intelligent spirit; for without these, the institutions, the enterprises, essential to his success can neither be established nor maintained. Each scientific society, if it is to live and thrive, must serve as a centre of upheaval for the community at large. If we unite and firmly bind ourselves in a society of restricted numbers, and with somewhat limited conditions of admission, this is not done with any unworthy purpose of discriminating in our own favor, or of confining to our membership the benefits of our association, but to give unity and distinctive character to our influence, that it may reach farther and go deeper than if the energy of our organization were to be chiefly spent in keeping ourselves alive.

And so we may inquire, what is to be our outside influence? I think that we may reasonably expect, acting within the limits of our organization, and along the line of our special purposes, to have a stimulating and directive influence upon the science work of the educational institutions and associations of this region, upon the local scientific societies with which we are connected, and, through our meetings and papers, upon the more intelligent part of the general public. While ours is not primarily an association of teachers, but of original workers in science, it so happens that most of us teach, and there is certainly no way in which we can advance science more effectively than by sending out classes of bright and ambitious pupils prepared for research. Discussions of the methods of this work must consequently always be in order; and besides this internal work and influence, I believe that we should lay down, advocate, and defend a few general principles—bearing, for example, on the relations of instruction and investigation, on the main ends of training in science, on the selection, arrangement, and co-ordination of subjects in each division of the courses in which we are especially interested; on the amount, kind, and time of introduction, of primary work in science preparatory to that of our higher institutions of learning, and the like. Preliminary, however, to any application of such principles to the actual situation in this region, we certainly and especially need to examine the situation itself, with respect to the institutions which we represent, to others not connected with us by membership of their instructors, and to the preparatory and high schools generally. I would greatly like

to see a committee or committees raised which should report to us at our next meeting a well-digested exhibit of these matters. Nothing could be more useful to us, and nothing, I think, would bring our work more directly and favorably to the notice of our immediate public. And then, in the papers and discussions of our school and college associations, in our State and more local scientific societies and academies, we should bring to bear the ideas and principles established by discussion here, and so carry the work outward by concerted action, as by a movement in line.

To our semi-scientific and scientific associates outside this body, we should, of course, carry whatever new thing of applicable value our meetings give us possession of, and thus enlarge the circle of the Society's influence. In these and other ways I hope that we might do much to increase the number of intelligent local observers and earnest independent students—now far too few in this region—and thus help to create and sustain a scientific sentiment, in which the present and approaching generation certainly fall far short of that now going out of action. It is a suicidal blunder to discourage the amateur, to undervalue the mere collector of specimens and reporter of facts, to create the impression, either wilfully or unwittingly, that none but the very learned have anything to do with the promotion of science. We cannot hang the truncated apex of our pyramid to the stars, not even to those of the German heaven—and if we could, we should not, for, after all, science is for man, and not man for science. The general public, it might seem, can scarcely be interested—even the more intelligent part of it—in a conference of specialists respecting their methods of technical work, and yet I think that this view is not altogether correct. Whoever cares for the results of scientific inquiry must usually be curious, at least, concerning the methods by which those often surprising results are reached—and frequently the method is by far the more interesting and the more easily understood. While much of our discussion of details would be tedious, and many fragmentary contributions incomprehensible, we might, I think, at least prepare at each meeting one or more evening programmes for the general public, setting forth fully and systematically several of the more remarkable and interesting processes of the biological laboratory and the geological office; the pure culture of bacteria,

the methods of minute measurement, and those of microphotography, the preparation of serial sections and the like—all to be used, perhaps, as illustrations of the general method of science at large. For, after all, the method of science, if the general public only knew it, is of greater importance to them than its matter. The method of science is simply the *sure* method, and the simplest and most economical consistent with certainty. Any other is either wasteful or unsafe. To know, to appreciate, to command this method, is to control resources beside which the mere knowledge of facts has but little significance.

It will be the most important public function of this Society to extend the knowledge and the use of the method of science, applied in the spirit of science, among the unscientific. The great mission of science is two-fold—to reveal the universe, and to rationalize the human mind. The first of these tasks, vast as it is, is still comparatively easy, for it is wrought out directly by the scientist himself applying the methods and apparatus of research to the facts of nature; but the second is immeasurably more difficult, because it can only be accomplished by a sort of a beneficent contagion affecting the spontaneous activities of the individual mind; by the persuasive influence of example, and a perceived superiority of results. To improve every occasion to expose, to commend, and to illustrate the scientific method, to encourage its application, to lead in its use in the common affairs of life and society—in business, in politics, in ethics, in whatever affects the welfare of man as a social being, is a duty to our kind, the importance of whose performance we shall never perhaps see more eloquently illustrated than by the occurrences of the present moment, when some of the greatest interests of one of the greatest nations of history are hanging on the decision of a purely scientific question by unscientific minds, worked upon by methods as little scientific as one can well imagine.

It thus seems certain, finally, that our young Society cannot languish for want of a field appropriate and peculiar to itself, for lack of a varied, greatly needed, and highly important work, beneficial to its members and to the general community—a work which nothing else is now attempting, and which, if we do not do it, seems likely to remain undone. The quality of our membership, the number and spirit of those in attendance on this, our first

annual meeting, the valuable character of our programme, are all an earnest of growth and active labor. Let us all lend the promising youngster our warmest wishes for a vigorous and useful career, and join in the cheer, long life, and a busy one, to the Western Society of Naturalists.

SKETCHES OF THE CASCADE MOUNTAINS OF OREGON.

BY E. D. COPE.

THE Cascade Mountains of Oregon are destined to be the favorite resort of tourists who love all that is most beautiful, impressive and wild in mountain scenery. Lying over one of the greatest of the fractures of the earth's crust, they represent the remains of successive outflows of molten material at its source. The basis of the range is eruptive, and displays the irregularities of surface due to such origin within comparatively recent geological ages, and to the rapid erosion which naturally occurs in a humid climate. Thus gorges of great depth traverse its masses, and precipices of tremendous height bound many of its elevations. Beautiful lakes nestle in its depressions, and waterfalls leap from level to level on their way to the tributaries of the Columbia. All is clothed in sombre forest of conifers, of larger proportions or more elegant foliage than can be found in any other region. High above all these mountains tower at intervals along the range, the great snow-peaks which give the region its especial beauty. These are extinct volcanoes which raised themselves round vents which long remained open, and which poured out lava, scoriæ, pumice and ashes, after the great fissure was closed.

The great lava outflow from the Cascade Mountain fissure is one of the most extensive the world has ever seen, and was one of the most destructive in its consequences. There were several distinct periods of outflow, two being especially distinguishable in the stratigraphy of central Oregon. Between the outflows from this and from lesser sources to the eastward, a country of eight hundred

miles in east and west extent, and one hundred and fifty miles from north to south, was covered with lava and other ejectamenta, rendering it uninhabitable by animal life. The volcanic materials are found for several hundred miles to the north, at some points continuously with the great tract I have mentioned. The exact connection with the latter remains to be ascertained; but both were deposited at about the same geological period; viz.: from some time in the Eocene to late in the Miocene ages. The area covered is not less than 1,600,000 square miles in extent, embracing all of central and southern Oregon and southern Idaho, and large tracts in Tacoma Territory. As an offset to this terrible and unexampled desolation of one of the fairest parts of the earth's surface, we have the great snow-peaks standing as silent and imperishable monuments of one of the most tremendous of the wars of the elements that the later earth has experienced.

The grand tour of Oregon is commenced by crossing the gap in the Cascade range at Ashland, just north of the California border, and visiting the Klamath Lake on the eastern side of the watershed. Turning northward, the tourist should visit the Crater Lake, twenty-five miles from Fort Klamath, and return. Then go northward again on the edge of the plateau that overlooks the valley of the Des Chutes River toward the west, from which the highest of the ranges of the Cascades rise, and may be seen in all their magnificence. Continuing on this road, now a stage route, the Dalles of the Columbia river are reached. Thence take the steamer down the river for Portland. The scenery of the long pass of the Columbia through the Cascade Mountains has been often praised, but never too highly. From Portland excellent means of transportation south, up the Willamet valley, will return the traveller to Ashland again, and the grand tour is completed. A trip from Portland to the resorts on the coast-range must not be omitted, for from these can be seen, it is said, twenty of the snow-capped summits of Oregon and Tacoma (Washington), on the one side, and the boundless waters of the Pacific Ocean on the other.

The traveller must make this journey in a private conveyance, if he can do so, excepting as to the Columbia River. He should commence at Sisson's, at Mount Shasta, in northern California. Then he will see the mountains in all their changing moods at his

leisure. He will become personally acquainted with each of the great landmarks as he passes them one by one. First, Shasta of colossal dimensions. Then the perfectly regular Mount Pitt, which overlooks Lake Klamath. Then the Batchelor with blunt apex; next Mount Cope, with its dome and its lower twin summit; and twenty miles to the north, the two peaks of Mount Condon joined at their bases, acute and inaccessible. At a longer interval follows Mount Jefferson, which rears its immense bell-shaped mass from a widely spreading base, to a height of 13,000 feet. Finally, near the Columbia, the perfect cone of Mount Hood lifts its head 14,000 feet and more to the skies. The form of all these peaks is essentially Andean. They are, like Popocatapetl, Cotopaxi, and Pichincha, of a general conical form, and thus quite different from the mountains of the Rocky range, or the Alps, which are mostly culminations of larger masses, or rise from plateaus, so that the visual effect of their elevation above the sea is largely lost. The case is quite different with ranges whose base is, like that of the Cascades, but little elevated above the sea. In the latter nearly the entire elevation is visible. The Cascades also, gathering the moisture from the ocean in a northern latitude, receive and display a greater deposit of snow than ranges of greater elevation in drier or more southern regions. (Plates XX and XXII.)[1]

Although there are many lovely lakes in the Cascade Mountains, none is so remarkable as Crater Lake. This is a body of water which occupies an extinct crater of large size. It is of an oval form and about eight miles by six in diameter. The walls which surround the water rise to a height varying from 900 to 3,000 feet, and they are so precipitous that their descent is practicable at very few points. At the time of my visit (in 1879) but one mode of access to the water was known to my guides. This I descended to the water's edge. It is a very steep washed slope covered with loose stones and scoriæ, among which the descent is much more easy than the ascent. To the south of the centre of the lake is an island which consists principally of a volcanic cone, with a distinct crater in its summit. This represents the latest centre of activity of the volcano. Its sides were covered with tall firs at the time of my visit. The depth of the water is very great. Captain C. E. Dutton, of the present U. S. Geological Survey, informed me that he

[1] The plates referred to will appear in the next number of the Naturalist.

obtained 1,900 feet as the greatest depth, and 1,500 as the average, in 1886. (Plate XXI.)

At the time of my visit Colonel Whipple was in command at Fort Klamath. He carried out a projected visit to Crater Lake at this time and kindly gave me the opportunity to accompany him. As we left the Post we were greeted by the clamor of the beautiful white-headed woodpeckers (*Picus albolarvatus* Cassin) which nested in the tall pines near the officers' quarters. We soon passed seven-mile creek, which abounds in the red-spotted trout of the Pacific coast, or the "dolly-varden" (*Salvelinus malma*), and commenced the ascent. We followed the course of a mountain torrent which often disclosed in its precipitous banks the friable volcanic material of which the mountain is composed. Sand and ashes, with here and there strata of fragments of scoria and lava were principally visible. The soil was evidently good, for it supported a luxuriant forest of trees and undergrowth. Prominent among the former are two beautiful firs, whose foliage is elegant but broadly contrasted in character and appearance. These are the *Abiës nobilis*, and the *A. pattoniana*. The foliage of the former is rigid, and the disposition of the terminal branches almost rectangular. The green is of a rather dark shade. The second species is, on the other hand, feathery in foliage and gracefully drooping in branches, and the green is paler. Above both these species towers the monarch of the north-west, the Douglass fir (*Abiës douglassii*), the largest species of its genus, forming the bulk of the forest. But it yields in height to the occasional sugar pine, *Pinus lambertiana*, with its graceful candelabra-like branches and long cones, the tallest of pines and a fit mate for the Douglass fir.

On our ascent we passed a herd of blacktail deer, which were browsing in security on an open slope of the creek banks. By evening we were encamped on a babbling run under the shade of towering firs. The whisky-jacks, *Perisoreus canadensis*, flitted from branch to branch, and descended to inspect our proceedings with their usual familiarity. Half jay and half titmouse, this bird makes a home of every camp, and tends no little to relieve the sense of savage wildness by its pretty and confiding ways.

By early morning we were at the summit. This was simply an open grassy expanse on the eastern edge of the awful chasm,

surrounded by an irregular border of the forest. The day was clear, and everything could be seen in perfection. Far down on the water I descried a moving white speck, probably a trumpeter swan, as no smaller bird would have been visible at the distance. Across the gulf rose the two points of the mountain called by the hunters the "Rabbit's Ears;" and further to the north-west the aiguille, known as "Cowhorn Peak." The water of the lake glistened in the sun, oblivious to the awful scenes that had once rendered this place the pandemonium of the continent. I descended to the water's edge, and examined carefully for traces of animal life. I found a very young larva of a salamander. More fully grown specimens have been since obtained by Lieutenant Carpenter, U. S. Army, and sent to the National Museum, which are probably the young of *Amblystoma macrodactylum*, the only salamander that has been found adult in that region. Then I found larvæ of Phryganeidæ and Ephemeridæ, and some minute crustacea, as Gammari and water-fleas. Among the rocks on and beside the slope, the "little chief" hare, *Lagomys princeps*, crept in and out, uttering the while its peculiar plaintive cry. It is a rather tame animal, and apparently possessed of much curiosity, but it has always a fissure in the rock at hand into which it retreats if one approaches too near.

The walls of the crater on the eastern side are made up of successive layers of lava, scoria, sand, ashes, pumice, etc., all representing successive eruptions and parts of eruptions. The mass is in places friable, and is penetrated by the waters of the lake at different points, thus giving origin to springs and streams.

At Fort Klamath the soil rests on a deep stratum of pumice. Some of the exposures show this to be broken up and water worn, but at other places it forms a continuous spongy mass. In a stratum of this kind, just below the soil, were cut the four graves of the Modoc Indians, who were hung for the assassination of General Canby, the commissioner sent by the United States to treat with the tribe. These graves were cut out with right angles and borders by the simple use of a sharp spade. At the time of my visit all of them had been rifled, and the bodies taken away. I afterwards obtained the skeleton of one of them. It is characterized by a platycnemic tibia, and tritubercular second and third superior molars.

Soon after this visit I left Fort Klamath for a geological explo-

PLATE XIX.—View from Lake Klamath, looking north towards Crater Lake.

ration of the Oregon desert. Of this I may have something to say at another time. I found unexpected assistance in this exploration through Mr. Charles Whittaker, son of the Governor of the State, who kindly placed his time and conveyance at my disposal, and accompanied me to Fossil Lake, and the sandy region beyond. We returned via Silver Lake, and took the main road for the Dalles. This road runs north along the western edge of the sage-brush and the eastern border of the valley of the Des Chutes river. There is nothing to obstruct the view of the Cascade range from this road, and as the greatest elevation of the range is at its eastern border, the view of it from this road is the finest that can be obtained. At a point twenty to twenty-five miles south of Prineville, nearly half the length of the Oregonian portion of the range is included in the panorama, at a least distance of seventy-five miles. From the line of forest-covered mountains rise five magnificent snow-peaks to heights varying from 10,000 to nearly 15,000 feet above sea level. To the north is Hood; then succeeds Jefferson; then Condon, Cope, and the Batchelor. As these mountains do not rise from a plateau as do those of Colorado, the effect they produce is more impressive than that of mountains of greater elevation in the latter region. The wedge of Hood and the cone of Jefferson only find their counterparts in the celebrated volcanoes of the Cordilleras, whose praises have been often celebrated; but nowhere can five Cotopaxis be seen at one view, but in the Cascades of Oregon. They are ideal mountains, grandly simple, whose outlines, rising from base to summit, are only interrupted by vast precipices. They pierce the blue sky with a vertical mile and more of purest white "as no fuller can white," save where the crags are too steep for the snow to cling. When I first saw Mount Hood, nothing but its cone was visible, an island of light, floating in a sea of clouds. When I saw it last, clouds had again separated its summit from the earth, and the rays of the sun gave it an Alpenglühn which resembled the red glow of a furnace, rather than the cold sheen of the ice-peak. Mount Condon is a double mountain, consisting of two peaks with sharp summits, connected by a high saddleback. Its outlines are as steep as those of the others, and it presents an immense surface of snow. Mount Cope is twenty miles south. Its summit is an obtuse cone surrounded by impassible precipices. It is next to Mount

Jefferson in elevation. These mountains are two of the four sometimes called the "Three Sisters." They were given distinct names by the late Dr. Hayden, director of the U. S. Geological Survey of the Territories, but his ill health and death prevented his issuing any publication on the subject. Mount Condon was dedicated to Professor Thomas Condon, of the University of Oregon, a distinguished teacher of geology, and the discoverer of the Miocene beds of the John Day river, of Oregon, which have produced so many remarkable vertebrate fossil remains. The Batchelor has an obtuse apex and resembles somewhat Mount Etna in its outline. A general view of these mountains is given in the accompanying sketches, which I took from two of our camps. One of the last views I gained of the snow-peaks was in the morning as the sun rose. The valley of the Des Chutes was, as before described, filled with white clouds, and these rose to such an elevation as to conceal all but the summits of the volcanic cones. As the sun's rays rested on them they all glowed with such intensity that they could be well compared to masses of red-hot iron suspended in the heavens; and by a stretch of imagination be conceived as once more in their hoary age, ablaze with their internal fires, attempting to revive the terrible glories of the past.

Our road took us away from these sublime scenes of the upper world, to equally extraordinary, if not as gigantic exhibitions of the ancient activity of the volcanoes in the bowels of the earth. We descended into the canyon of the Des Chutes and followed its course for many miles. The descent could not have been less than 2,000 feet, and was accomplished by zigzags and stages innumerable. Prof. Newberry has described this canyon in his report in the series of the U. S. Pacific R. R. Survey volumes. Its walls display a remarkable section of the materials which the eruptive forces cast far and wide, or forced to flow over this afflicted country. High upon the walls of the canyon is a horizontal layer of columnar basalt, the columns vertical. Below this, separated by many feet of a friable deposit, is a stratum of well defined, apparently sedimentary, rock. A deep bed of ash is followed below by another bed of columnar basalt, and this again after an intermediate soft stratum, by a third bed. In the two lower beds the columns are variously disposed. They are frequently curved, forming concentric arcs,

disposed in various directions according to locality. Sometimes the columns are horizontal, resembling piled cord-wood, and all are generally regular and more or less artificial looking.

From this extraordinary gorge we finally issued on a rolling country well covered with bunch-grass, which continued to our destination, the Dalles, on the Columbia river.

EDITORS' TABLE.

EDITORS: E. D. COPE AND J. S. KINGSLEY.

In the annual address of the President of the Biological Society of Washington, Mr. G. Brown Goode, Assistant Secretary of the Smithsonian Institution, uses the following language:[1] "I think the general tendency of a careful study of the distribution of scientific men and institutions, is to show that the people of the United States, except in so far as they sanction by their approval the work of scientific departments of the Government, and the institutions established by private munificence, have little reason to be proud of the national attitude towards science." This indictment is brought after a careful survey of the ground by a naturalist of undoubted competency, and of exceptional opportunities for acquiring information. We are compelled to agree with Secretary Goode, and can, we think, point out some of the conditions of this state of affairs.

Our complaint is that the average American citizen does not know what original scientific research is, and that if he acquires wealth, and wishes to do something for the benefit of his fellow-men, as he does more frequently than the citizen of any other country, he does not do anything for the *production* of knowledge. He devotes money to schools and to libraries, but towards the creation of the books to be used in them, and the truths to be taught in them, he does nothing. Forgetting the lessons of his business training, he apparently imagines that knowledge is derived from some mysterious internal process of the mind, and that the producer

[1] 1887, pp. 92–3.

needs neither material nor apparatus. He supposes that he can make money and scientific discoveries at the same time, and so does not need food, clothing, nor shelter. Or if these essentials be provided, he exacts such an amount of teaching from the unfortunate recipient, that scientific production is suppressed at its fountain-head. Yet these good people like to talk about the scientific progress of the age, and of the benefits that it confers on mankind. Of course most of this comes from an ignorance of what great fields of knowledge remain yet unexplored, and an incapacity to understand what a change will be wrought in our thoughts and acts by the acquisition of that knowledge. The solution of the great mystery of the relations of mind to matter has no interest for them; or, if it has, carries with it no impress of utility. Perhaps some people of little faith fear the results of such knowledge, not reflecting that it is better to traverse the paths of life and death with one's eyes open, rather than with them shut.

The actual state of original research in America justifies the language of Secretary Goode. The number of positions available for the original investigator in the country is small, and many of these are occupied by incompetent persons who add little or nothing to scientific knowledge. Our so-called "Academies of Science"[1] have become lyceums, where little beyond popular display and instruction is attempted. It is true that most of these societies publish "Proceedings," etc., but whence the material to fill these publications with worthy matter is to come, they do not concern themselves. The perversion of these societies from their true object is inevitable, so long as they are compelled to elect members for financial reasons.

After Academies of Science come the Universities. Here the same spirit presents the same obstacles to research. But little time is granted the professors in most of them, and in one case the position has been distinctly announced, that original research does the University no good. The philistinism is here fairly expressed, and the issue is made. Continental Europe is, however, against this modern barbarism, and progress can still find congenial climes. Germany still turns out her volumes rich with observation and thought, on a financial basis so small as to furnish little more than buttons and kid gloves for a fashionable American family.

[1] Except the U. S. National Academy.

But Americans are not Germans, replies a gentleman "of the old school". If so, what is the difference? We have the financial ability, and there is no deficiency of mind in certain classes in the United States. One answer is, that there is a dissociation of the mind and the money. Occasionally an attempt is made to effect a combination. Sometimes the method is grotesque; as when a wealthy merchant recently offered a University the sum of $200,000, to put his son through a four years' course, and make him a professor afterwards. Sometimes the attempt is successful, as in the case of the Allis Laboratory of Milwaukee. We can only say may there be many Allises in the future of our history, and may they be as judicious in their selection of workmen.

We suspect, however, that this state of affairs will not last. The Universities are doing their good work of educating the people, and from these will spring, from time to time, men who understand the growth of the human mind, and how to aid it.

RECENT LITERATURE.

WINCHELL'S GEOLOGICAL STUDIES.[1]—In this work we have an aid to the study of Geology in its various departments, which will have a distinct influence in advancing the knowledge of the science. The student, whether in the school-room or in the field, will find its utility undoubted, whether the clearness of the descriptions or the excellence of the illustrations be taken into account. The long experience of the distinguished author, both in original research, and in teaching, qualify him especially for the production of a work like the present. The departments of stratigraphic and dynamic geology may be specified as the best, as they are the most extended divisions of the book. We cannot speak as highly of the palæontological part. The list of the "most important types of animals and plants," beginning on page 305, is mostly constructed either after antiquated models, or else after false lights of modern character. The Vertebrata are especially bad, and the nomenclature adopted is mostly one which the student will have to forget, if he or she be so unfortunate as to have remembered it. With this defect remedied in future editions we can heartily recommend the work for general use.

[1] Geological Studies or Elements of Geology for High Schools, Normal and other Schools; with 367 illustrations. By Alexander Winchell, LL.D. Second edition. Chicago: S. C. Griggs & Co. 8vo. pp. 513.

Jordan's Manual of the Vertebrates.[1]—In this, the latest edition of this well-known work, Dr. Jordan has completely revised the text, turning it end for end, condensing and rewriting almost every page, as well as increasing its scope by admitting to its pages the littoral forms of the Atlantic Coast of the United States. The work is apparently fairly well done both by author and manufacturer, though we might criticise the classification adopted in some cases, or pick out here and there errors of anatomical statement, for Dr. Jordan is confessedly no anatomist, but takes his structural knowledge at second hand. Books of this kind constitute the most popular and useful introductions to the sciences of which they treat, but it must be remembered that they constitute introductions only.

The fault lies not in the keys but in the use to which they are put. They serve the poor teacher, and enable him to do the poorest kind of work with the least possible expenditure of brain force. All he has to do is to give the student a bird or a fish and one of these manuals and the work is done. The poor student, imagining that he is deriving mental discipline by the operation, but not clearly realising where it comes in, struggles with the inoffensive fish or fowl down through pages of "keys," until at last he captures a Latin name which seems to fit it. As has been wittily said, "it is like tracking a woodchuck to a hole, when you get there all you have is a hole." Yet this process is daily going on in hundreds of our high-schools and scores of our colleges to-day. In many an institution which rejoices under the name of University the biological students never learn a single anatomical fact, never hear a single embryological statement; their whole knowledge of the varied forms of life around them consists in having learned the names of a few dozen vertebrates and flowering plants. While the botanical manuals of Wood and Gray are largely responsible for the wide taste for botany in the United States, they are too often regarded as the *summum bonum* of the science by the teacher. True zoologists must be on the alert or similar works upon the animal side will be used in the same superficial way.

[1] Jordan, David Starr. A manual of the Vertebrate Animals of the Northern United States, including the district north and east of the Ozark Mountains, south of the Laurentian Hills, north of the southern boundary of Virginia, and east of the Missouri River. Inclusive of Marine species. Fifth edition. Chicago, 1888. Pp. 375.

RECENT BOOKS AND PAMPHLETS.

Studies from the Morphological Laboratory of the University of Cambridge. Vol. III. Part 2. From the Balfour Library.

Behrends, Gerhard J.—Beiträge zur Kenntniss der Entwickelung des Nervus opticus und des Glaskörpers bei Säugethieren. Erlangen, 1888. From the author.

De Man, J. G.—Crustacea of the Mergui Archipelago. Part III. Ext. Jour. Linn Socy. Vol. XXII. 1888. From the author.

Heathcote, F. G.—The Post-embryonic Development of Julus terrestris. Ext. Phil. Trans. 1888. From the author.

Edwards C. L.—Winter Roosting Colonies of Crows. Am. Jour. Psychology. 1888. From the author.

Mitsukuri, K., and Ishikawa, C.—On the Formation of the Germinal Layers in the Chelonia. Ext. Q. J. M. S. XXVII. 1886. From the authors.

Weismann, A., and Ishikawa, C.—Ueber Partielle Befrüchtung. Ext. Bericht Naturf. Gesellsch. Freiburg. 1888. From the authors.

Beddard, F. E.—On Certain Points in the Visceral Anatomy of the Lacertilia, particularly of Monitor. Ext. Proc. Zool. Soc. London, 1888.—Visceral Anatomy of Balæniceps rex; The respiratory organs in certain diving birds. Ext. Proc. Zool. Soc. London, 1888. Both from the author.

Shufeldt, R. W.—Observations on the Morphology of Gallus bankiva. Ext. Jour. Comp. Surg. and Med. 1888. From the author.

Goode, G. B.—The Beginnings of American Science in the Third Century. Ext. Proc. Biol. Socy. Washington, 1888. From the author.

Fewkes, J. W.—On the origin of the present form of the Bermudas. Ext. Proc. Bost. Socy. 1888.—A new marine Larva and its affinities. Ext. The Microscope. 1888. Both from the author.

Hargitt, C. W.—Recent Notes on Scaphiopus holbrookii. From the author.

Shufeldt, R. W.—The Osteology of Habia melanocephala, with comparative notes on the skeletons of certain other Conirostral birds and of Tanagers. Ext. Auk. Vol. V. From the author.

GENERAL NOTES.

GEOGRAPHY AND TRAVEL.[1]

General.—The Voyages and Fate of La Perouse.—Apropos of the centenary of the death of La Perouse, the *Bulletin of the Geographical Society of France* gives a summary of the voyages of that unfortunate navigator. The *Boussole* and the *Astrolabe*, under his command, left Brest August 1, 1785, doubled Cape Horn on February 8 of the next year, reached the Sandwich Islands in May, made the coast of America near Mount St. Elias on June 23, followed it to Monterey, and thence crossed the Pacific to Macao. On April 9, 1787, the expedition started again to reconnoitre the Japanese Isles and the coast of Tartary. The island of Dagelet was discovered May 27; the strait of La Perouse, between Saghalien and Jesso, soon after; and on December 9 the vessels anchored at Mauna, one of the Navigator group. Here M. de Langle, the commander of the *Boussole*, together with the naturalist Lamanon and ten men, were surrounded by the natives and killed. The last letter that reached France from La Perouse was dated February 7, 1788. The story of the discovery of the remains of the expedition at Vanikoro, in the Fiji, is told by Vice Admiral Paris, the last survivor of the expedition sent out in 1826 under the orders of Dumont d'Urville. The *Astrolabe*, commanded by this captain, was only a small transport bearing the name of a corvette. At Vanikoro information was obtained that five bronze cannon and some skulls of Europeans were in possession of the natives, and also that a vessel had been wrecked there and its crew massacred. The débris of the frigate *Astrolabe* was finally found opposite the village of Paiou. A monument to the memory of La Perouse was raised upon the islet of Manevai.

Asia.—The Ethnography of Hindustan.—F. v Hellwald (*Ausland*, Nos. 31–35) has an article upon the ethnography of Hindustan. The 252,000,000 of inhabitants belong to four races, black, yellow, Turanian, and Aryan. The primitive population consisted of two types, one Malay, still to be found in the south and on the Malabar coast; the other Semitic, still existing in the Nilghirries and in the north of India. This primitive population was driven back by Turanians descending the Brahmaputra valley, and these invasions precede the historical period. The mixture of these Turanians with the indigenes gave rise to the Protodravidas,

[1] Edited by W. N. Lockington, Philadelphia, Pa.

and from the mingling of the latter with the Mongols arose the Dravidas or Tamals. The defiles of Afghanistan first let in the Turks, who spread over the Indus valleys, and afterwards the Aryans, who extended their rule to the Vindya Mountains, and further south became mingled with the older peoples, forming the Bheel, Dhang, and other tribes. In the eleventh century the various Mussulman peoples added to the ethnographical confusion.

THE AMUR VALLEY.—M. Venukoff contributes to the September number of the *Revue de Géographie* an account of the region of the Amur, which he characterizes as fit for colonization. The vast country watered by the Amur and its affluents, the Zeya, Bureya, Tunguska, etc., flowing from the Stanovoy mountains, consists of fertile plains and rolling or rugged surfaces in about equal proportions. The fertile part comprises an area equal to a third of that of France. This plain country consists chiefly of five separate portions, two of which, that in the basin of Lake Evoron and that upon the lower Amur, have a fresh and humid climate, while the other three, higher up the Amur, and reaching to the base of the Touine, Wanda, and Little Khingan mountains, offer all that is necessary for the existence of European agriculturists. The population of these plains does not at present exceed 85,000 Russians, Chinese, Coreans, and Tungusians all told.

AFRICA.—THE FRENCH IN SENEGAMBIA.—The progress of French rule in the Senegambian region since 1881 has been very considerable. At that date Colonel Borgnis Desbordes left St. Louis, imposed contributions on several rebellious chiefs and entered Kita early in 1882. Though he had only 220 fighting men and could expect no help from the timid indigenes, he entered into a campaign against Samory. The latter was defeated, and the town of Keniéra fell into the hands of the French. Those who doubt the propriety of European interference in Africa, would do well to read M. Pietri's description of the sight which met the conquerors on entering the town. "In the plains around the village were corpses and their detached heads; a little farther rose heaps of cinders yet burning and mingled with the blackened bones of the prophet's victims, and the wells of the village were also full of corpses. * * * * * * Our soldiers found some unfortunates still alive, suffering from ugly wounds, the executioners not having had time to finish them. Even these horrors were less harrowing than the sight of the families of the victims, naked, fleshless, living statues of hunger who stretched out their arms to our soldiers praying for food." In 1882 the same Colonel attacked and took Murgala and Daba, thus breaking the power of the Toucouleurs and also of the Bambaras, who bravely defended the latter town. Bamaku, on

the Niger, was reached early in 1883, but a league was formed against the French, and the Spahis, spite of their bravery and the great loss of the enemy, were compelled to retreat, only again to advance and gain victory after victory, thus assuring the domination of the Upper Niger and the rule of a country equal to a third of France.

The French in Senegambia soon encountered a new enemy in the person of Mahmadu Lamine, a Mussulman of Kayes, who resolved to found a new empire in the Sudan by playing the rôle of prophet. In 1886 the marabout had fifteen to twenty thousand men grouped around Kayes, yet by the end of the year his power was broken. A treaty was made with Samory in 1887. He accepted the Tankisso as the limits of his state and placed his country under French protection.

M. Vigué (*Rev. Sci.*, Oct. 27, 1888) contributes an interesting article on the tribes of Senegambia. Notwithstanding the chaos of tribes the author believes that all the indigenous peoples may be referred to two stocks; one of them the Guinean proper, the other comprising the Mandingoes, Fulahs, and tribes formed by the intermingling of these two. The numerous foreign Sudanese, Walofs, Toucouleurs, etc., are not comprised in either of these categories. The peoples of the coast of Senegambia, all of them miserable fetichists, appear to be of the same stock with the more powerful tribes found further south, such as the Ashantis and nations of the Lower Niger. These Guinean tribes have been pushed back by the invading Mandingos and Fulahs, until only a narrow strip on the coast was left to them, and would without doubt have disappeared altogether had it not been for the advent of Europeans.

AMERICA.—M. THOUAR'S CONCLUSIONS.—The last expedition of M. Thouar in the region of the Chaco led him across a waterless desert and the sufferings of the party were very great. Several men deserted, and out of twenty-one men only three returned alive. In his report presented to the Bolivian Government, M. Thouar came to the following conclusions: (1) That the northern part of the Chaco is entirely arid and waterless, (2) that the opening of a wagon road across this region is impracticable, (3) that a railroad from Sucre to Pacheco would not pay, but (4) that the opening of the Pilcomayo needs only some simple works of canalization, which would be largely compensated by the profits drawn from the auriferous sands and fertile lands of its coast.

EUROPE.—THE FAROËS.—The Faroë Islands are twenty-six in number, and have a total area of 1,333 square kilometres. Seventeen only are inhabited. Almost all are elongated in a north-

west and southeast direction; this is also the direction of the fjords that intersect them. Stromö and Osterö, the two largest, have summits of 800 and 970 metres, and a mean altitude of 300 metres; they are cut up by deep valleys which are continuations of the fjords. All the islands are elevated and surrounded by cliffs. The group is composed of beds of basalt, mingled with carboniferous strata. The volcanoes which produced the basalt must have been well to the west of the archipelago. The islands have a very humid climate; Torshavn receives two metres of rain annually, spread over 267 days of the year.

The Faroë Islands were colonized in the ninth century. Christopher Columbus visited them in 1467. The inhabitants retain some traits of the old Vikings; they are tall and strong, with blonde hair and red beards. The women do not cover the head. The sheep is to the inhabitants of the Faroës what the reindeer is to the Laplanders, and its flesh, with the produce of the fisheries and the eggs of sea birds, constitute the main food of the islanders. Thorshavn is the political centre, but its harbor is obstructed by ice in the winter. Another important port is Kirdeböe.

THE OSCILLATIONS OF THE SWEDISH COAST.—M. L. Holmstrom (*Revue Scientifique*, Sep. 8) brings together the varied observations of Celsius, Runeberg, Gissler, Nordenanckar, Hällström, Wikström, Lyell, Erdmann, Bruzelius, Forssman, Börtzell, and others, relative to the changes of level in the coast of Sweden. There is full proof of a lowering of the sea level on the western coast of Sweden during the last forty years. Marks cut in the rock show the levelings in 1847, 1867, and 1870, and the present level of the seaweed indicates an annual sinking of 0^{m}, 40. M. Holmstrom states that he knows no fact tending to show that the Norwegian coasts are now changing level, but those of Finland seem to vary in an analogous manner to those of Sweden. M. Holmstrom does not consider that the lowering of the sea level is by itself a proof of the rising of the land, since it is now well known that the ocean service is not exactly spheroidal, but is elevated by the attraction of elevated continental masses.

So long as the relative masses of the continents remain the same no alteration can take place in the mean sea-level, but augmentation or diminution of the land masses cause a rising or falling of the sea-level.

GEOGRAPHICAL NEWS.—EUROPE.—The mortality of Madrid during the last ten months has been forty-five per 1,000 and that of the last eight years has been 41.7. Epidemics of small-pox and diphtheria, caused by the defective sanitation of the city, largely account for this high mortality.

According to statistics brought together by M. Turquan, an average number of seventy-eight centenarians, twenty-seven men, and forty-six women, die annually in France. This average is based on 1,474 observations. The northern slope of the Pyrenees seems to be a favored region for longevity, since 38.8 per 100,000 in the Hautes Pyrénées and 38.4 in the Basses Pyrénées attain 100 years. The percentage diminishes northwards, but increases somewhat in the basin of the Seine.

The *Bulletin of the Alpine Club* states that immense caverns containing a subterranean lake and water-courses which seem to be connected with the river Yonte, have been discovered by M. Fabié in the Casse Mejean, an isolated mountain 900 to 1,300 metres in height.

ASIA.—Disguised as a Mussulman, Dr. Hurgronji, of Leyden, has resided six months at Mecca. The city has not sensibly changed since it was visited by Burkhardt, in the beginning of the century. This traveller denies that the black stone of the Kaaba is a meteorite, since a similar stone occurs in the sacred mountain of Abu Gübez.

AFRICA.—By the protectorate over Bechuanaland and the country of the Makalekas and Machonas, recently assumed by Great Britain, the Boer republics are entirely surrounded by British possessions, except where they touch Portuguese territory on the east. Zululand has also been declared British territory, but will form a distinct colony from Natal.

The old State of Harar, once governed by an independent emir, and afterwards annexed to Egypt, has, since March, 1887, been in the possession of Menelik, king of Shoa.

England took possession of the island of Socotra on November 30, 1886.

The English have abandoned their claims to the southern coast of the Bay of Tadjura, in the gulf of Aden, and a considerable portion of the western shore of that gulf is now under the protection of France.

As the Baptist Mission of Victoria was within the bounds of the Cameron country, which by the Anglo-German convention of 1885 belonged to Germany, it has been given up, and is now occupied by missionaries from Basle.

Great advances have been made in the knowledge of the geography of Madagascar since the treaty concluded between the French and the Hovas, in December, 1887.

The new republic founded by the Boers, on the frontiers of the Transvaal and of Natal, in the territory of the Amazulu, is now annexed to the Transvaal repuplic.

The atlas of Morocco, by M. de Foucauld, is a most valuable addition to the geography of the north of Africa. The lines of mountains and rivers shown on previous maps are here considerably modified. The Atlas range in Morocco is composed of three parallel chains instead of one, and the course of the Dra is found to be in its upper part half a degree to the west of its previously supposed position.

Captain Pleigmeur, who was commissioned to study the levels across the French African territory, between the Atlantic Ocean and Stanley Pool, was drowned in the River Niari.

The Northwestern African Trading Company, which succeeded to the rights of Mr. Mackenzie at Cape Juby, near the frontier of Morocco and opposite to the Canary Islands, imposes a duty of from ten to twenty per cent. upon merchandise going into Morocco. The factory of this company was recently attacked by the natives, and the director, M. Morris, was assassinated.

In May, 1888, news was received from Cairo respecting Lupton, Slatin, and the other prisoners of the Mahdi. Their situation is the most miserable possible, they are condemned to the hardest and most humiliating tasks. To negotiate for their release would be trouble lost, to organize an expedition would be to hasten their death. None the less it is a shame to leave Europeans in this deplorable condition.

GEOLOGY AND PALÆONTOLOGY.

Description of New Species of Fossils from the Rockford Shales of Iowa.—Professor Newberry, in speaking of the mingling of the Devonian fauna of Ohio,[1] says: "The mingling of the fauna of the Hamilton and Corniferous is apparently somewhat greater here than in New York, but this is readily explained by the fact that here, as in other portions of the Western States (Iowa included), there were no such striking alternations of conditions during the successive deposition of strata as are indicated at the east.

"An open sea prevailed throughout several successive periods at the west, and during these an unbroken series of limestone strata was formed, while at the east alternating shore and off-shore conditions interposed sheets of mechanical sediment, and gave more distinctness to the fauna of each formation."

[1] Geology of Ohio, Vol. I., p. 144.

Now, however applicable these statements may be to the Devonian rocks of other States, they certainly are not, to any such degree, applicable to the rocks of this age in Iowa. The Devonian rocks of this State, as observed by Dr. White,[1] are serially isolated.

The occurrence of extensive beds of very coarse and fine-grained sandstone, varying from five feet to forty feet in thickness (sometimes obliquely and discordently stratified throughout), and blue and buff shales, some of which are extensively sun-cracked, and others containing abundant remains of land plants, as well as extensive beds of blue clay and hard, fine-grained and compact limestone, and the varying fauna of the several divisions, all attest that there were nearly equally as striking alternation of conditions during the successive deposition of strata in Iowa as are indicated "at the east;" and that the alternating shore and off-shore conditions which interposed sheets of chemical and mechanical sediment, have, to a greater or less degree, given a distinctness to the fauna of the several divisions equal to that "of the east."

An interesting and instructive feature of the exceedingly rich fauna of the Rockford Shales of Iowa is the extreme minuteness of a considerable number of its fossil species. Of these minutissimic, yet adult, forms, more than fifteen are Gastropoda, four Brachiopoda, three Crustaceans, four or five Foraminifers (suborder Perforata), and five or six small Bryozoan corals. These forms, which comprise slightly over one-seventh of all those known to occur in this formation, are usually well represented both as to genera, species and individuals.

The organic life of the old Devonian sea in Iowa culminated in these shales; and at this time was ushered in a period when the conditions were much more favorable to the existence of life than at any other epoch of the Devonian age in this State. Immediately underlying the Rockford Shales is a stratum of dark blue clay from twenty feet to twenty-five feet in thickness, and entirely destitute of organic remains; this attesting conditions, when the material was laid down, extremely unfavorable to the existence of any form of life. Upon the ushering in of conditions under which the material of the super-incumbent shales was deposited, the change from the pre-existing conditions was very abrupt.[2]

Although the change in the character of deposition here was very sudden, yet the change as to congeniality to life seems not to have been so rapid, as appears to be attested by the fact that nearly all the depauperate forms above enumerated occur at the *base* of these shales.

[1] White's Geology of Iowa, 1870.

[2] There are nowhere beds of passage from the blue clay below to the shales above, the change having been everywhere very rapid and sharply defined.

But that conditions eminently favorable to the existence of life finally took place, is demonstrated by the fact that from a few feet above the base of the formation to the top of it, the strata is crowded to repletion with various normal, and often large, forms of life.

As will be observed by the enumeration, Brachiopods form but an inconspicuous feature of the fauna at the base of the shales; while the fauna of the higher horizons of this formation shows a preponderance, both as to numbers of species and individuals, of this class of organic remains.

In general, the different classes of fossil remains, as Brachiopoda, Gastropoda, Crustaceans, etc., are restricted in their vertical range to certain definite horizons, and so do not occur in equal force throughout the entire formation.

This paper, together with others published and in press, are preliminary to a Monograph on the Devonian formation of Iowa.

Rhynchonella subacuminata, n. sp.—Shell somewhat variable; sub-triangular in marginal outline; greatest width above the centre of the shell; contracting quite rapidly to the front, where it terminates in three sharp angles, which are produced by the sharply angular folds on the front of the valves. Dorsal valve strongly convex in the centre; furnished with three prominent sharply angular folds at the front, which usually become obsolete before reaching the centre of the shell; sinus, large, deep, and broadly rounded; margined in front by from two to three sharp, short folds; front and cardinal margins sharply serrate. Surface of shell smooth; texture fibrous. In the young specimens of this species, folds or elevations are not present on any portion of the shell.

Position and locality: Rockford Shales, Hackberry, Cerro Gordo county, Iowa.

Athyris minutissima, n. sp.—Shell minute; subovate in outline; valves strongly and nearly evenly convex; greatest convexity above the middle; cardinal margins sloping rapidly to slightly below the centre, thence rather broadly curving to the front. Ventral valve slightly more convex than the dorsal valve; umbo prominent; beak sharp, and incurved over the beak of the opposite valve. Dorsal valve slightly less convex than the opposite valve; umbonal region strongly convex. Surface marked by strong equi-distant imbricating lines. Neither valve has an elevation or depression at the front that would correspond to a mesial fold or sinus.

Dimensions: length, $2\frac{3}{4}$ mm.; greatest width, 2 mm.

Position and locality: lower portion of Rockford Shales, Rockford, Floyd county, Iowa.

Paracyclas validalinea, n. sp.—Shell rather large, oblong, subcircular in marginal outline; length and breadth usually unequal; dorsolateral portion of the shell strongly produced. Valves ventricose; most strongly so at or slightly above the centre; cardinal line strongly arcuate; beaks prominent and strongly curving forward, distant, situated centrally or very nearly so. Muscle impressions large, and in well preserved specimens distinctly marked; the posterior one sub-circular; the anterior one obliquely subreniform, and considerably smaller than the posterior one. Pallial line prominent, parallel to which is a prominent row of pustules arranged side by side. Surface unknown.

This shell differs from any form previously described that is known to me. This form is known only by its cast, of which over one hundred specimens have been secured.

Position and locality: Rockford Shales, Rockford, Hackberry, and Owens' Grove, Iowa.

Platystoma mirus, n. sp.—Shell very minute; suborbicular in outline; spire nearly on a plane with the body whorl; volutions about three. Outer volution large, strongly convex, rounded; suture not very distinct; aperture sub-circular; outer lip of moderate thickness with entire margin; columella lip not distinctly produced; umbilicus closed. Surface smooth.

Dimensions: diameter, 1 mm.; height, $\frac{3}{5}$ mm.

Position and locality: lower portion of Rockford Shales, Hackberry, Iowa.

Platystoma pervetus, n. sp.—Shell semi-circular to subovate in outline; spire elevated but little above the body whorl; volutions about three; the body volution very large, rounded, and very convex; suture well defined; aperture sub-circular; umbilicus deep. Surface smooth.

Dimensions: greatest diameter, $\frac{3}{4}$ mm. to 1 mm.; vertical height, $\frac{3}{4}$ mm. to $\frac{1}{2}$ mm.

Position and locality: lower part of Rockford Shales, Hackberry, Iowa.

Naticopsis rarus, n. sp.—Shell somewhat subovate in general outline; spire slightly prominent, depressed; volutions three; convex, rounded; increasing rather rapidly in size from the apex; body whorl large, forming by far the greater bulk of the entire shell; broadly rounded on the sides. Suture distinct; aperture subovate; outer lip thick; inner lip not defined. Surface smooth.

Dimensions: height, $1\frac{1}{2}$ mm.; greatest breadth, $1\frac{1}{5}$ mm.

Position and locality: base of Rockford Shales, Hackberry, Iowa.

Turbo strigillata, n. sp.—Shell turbiniform, thick; spire depressed, conical; whorls four, increasing rapidly in size from the apex; those of the spire convex, but not distinctly rounded; last

one large, strongly inflated; lower portion rounded; upper surface somewhat flattened, and marked by a distinct revolving groove or depression, which becomes obsolete on the second volution, or almost before reaching it. Suture from nearly linear at the apex, to comparatively deeply channeled below; aperture orbicular; outer lip thick, entire; columella lip very thick, especially the lower portion. Surface of body volution ornamented by strong sub-equidistant, oblique, sinuous lines.

Dimensions: vertical height, 2 mm.; greatest width, 2 mm.

Position and locality: base of Rockford Shales, Hackberry, Iowa.

Turbo (?) *incertus*, n. sp.—Shell conical, turbiniform, comparatively thick; volutions four, moderately increasing in size; the upper ones convex, but little rounded; the last one large, and somewhat more rounded than the upper ones; the second whorl has also a slightly more curved outline than the two upper ones; suture well defined; aperture imperfect, but apparently discoid. Surface marked by simple straight lines.

Dimensions: vertical height, $2\frac{3}{4}$ mm.; diameter at base, $1\frac{3}{4}$ mm.

Position and locality: base of Rockford Shales, Hackberry, Iowa.

Holopea tenuicarinata, n. sp.—Shell thick, small, sub-coniform; spire rather rapidly tapering; volutions four, convex, flattened above; the body whorl ventricose, rounded, nearly or quite equal in height to all of the others; slightly produced in front. Exact form of the aperture unknown, but judging from the portion which remains unbroken, it was subovate in outline; the portion of the outer lip which remains is thick. Suture sublinear above, and slightly channeled below. Surface ornamented by rather obscure, oblique, curved lines.

Dimensions: height, 2 mm.; greatest width, 1 mm.

Position and locality: base of Rockford Shales, Hackberry, Iowa.

Cyclonema brevilineata, n. sp.—Shell turbonate; rather thin; spire strongly depressed, conical; volutions three, increasing quite rapidly in size; those of the spire convex, rounded; last one large, somewhat more broadly rounded than the upper ones; upper surface very slightly flattened; suture well defined below, but not so distinctly defined above. Aperture ovate to sub-circnlar. Surface of body whorl marked by strong revolving lines or ridges, which become obsolete (except in the case of one specimen) on the second volution; interstices about equal to the width of the revolving ridges; surface of the upper volutions smooth. The revolving lines on the first turn show, under a strong magnifier, a more or less strong crenate character, though not caused by lines of growth.

Dimensions: greatest width, $1\frac{1}{2}$ mm.; vertical height, 1 mm.

We have in our cabinet many specimens of this species, all of the same form and size, and showing (with the single exception noted) the same surface marking.

Position and locality: base of Rockford Shales, Rockford and Hackberry, Iowa.

Cyclonema subcrenulata, n. sp.—Shell small, sub-turbonate; spire depressed, sub-conical; volutions three, increasing rapidly in size from the apex; those of the spire slightly convex, flattened; last one large, equal to two-thirds the bulk of the entire shell, convex, flattened, or very broadly rounded; rounded at the periphery; suture well defined; aperture oblong-ovate. Surface ornamented by strong, sharply elevated, revolving ridges, which are distinctly crenated by the strong, slightly oblique lines of growth. Of these revolving lines, fifteen may be counted on the body volution in close proximity to the periphery, three of which are very minute, and implanted between the main ridges; these are rather short, as well as one of the main ones which joins the suture. On the upper portion of the body whorl, between the suture and the first revolving line, is a flattened or slightly concave space, which is marked by stronger and more oblique striæ than other portions of the surface of the shell; on the whorl next above the body volution, four revolving lines may be counted.

This species seems to be somewhat closely related to *C. crenulata* of Meek (*Geological Survey of Ohio, Palæontology*, Vol. I., p. 213, Plate XIX., Fig. 2, a, d), but differs from it in its more strongly depressed form, less number of volutions, and slightly different form of the aperture; it also has a less number of revolving lines (three of which are minute and implanted), and a more profound crenate character, as well as the distinct belt or flattened area occupying the upper part of the first volution.

Dimensions: height, 11½ mm.; greatest width, 11½ mm.

Position and locality: lower portion of Rockford Shales, Rockford, Iowa.—*Clement L. Webster.*

HANDBUCH DER PALÆONTOLOGIE OF ZITTEL.[1]—We welcome another installment of this excellent work, which carries the subject to the end of the Batrachia from the Actinopterygia, mostly inclusive. We have already indicated our dissent from the classification of the fishes adopted, but the very full references to the literature of the subject in this work furnish the alternatives to the student We notice some typographical errors (as Ganorhynchus for Gonorhynchus, and Scyllæmus for Syllæmus), and a few errors of nomenclature of no great importance. An error once started, often has a strong vitality, as in the case of the name Daptinus Cope, which I

[1] Unter Mitwirkung von Dr. A. Schenk. Palæozoölogie; III Bd., 25 lieferung; 154 Holzschnitten. Teleostei (finis) et Batrachia.

long since showed is the Saurodon of Hays, of much prior date; and Protosphyræna Leidy, which, if it be used at all, belongs to the species *P. striata*, and not to the genus Erisichthe Cope. The name Saurodontidæ Cope should not be replaced by Saurocephalidæ of later origin, because Saurodontidæ Zittel, of later date than either, has been applied to another family, which should, if well defined, have another name.

In the Batrachia, Professor Zittel divides the Stegocephali into three primary groups, the Lepospondyli, Temnospondyli, and Stereospondyli. In the first the vertebral centra consist of a simple sheath round the chorda dorsalis; in the second the centra are segmented; and in the third they are amphicœlous and "completely ossified." The author does not adopt the divisions Ganocephala, Rhachitomi, and Embolomeri. There are serious objections to the system proposed by Prof. Zittel, which I will state. There does not seem to be any real difference between the Lepospondyli and the Stereospondyli, since a tubular vertebral centrum passes by the most insensible gradations into an amphicœlous one. The Temnospondyli cannot be regarded as homogeneous, or exactly defined. In fact, the vertebral centra of the Embolomera are not segmented, but are as entire as in the other two divisions of Zittel. The presence or absence of two occipital condyles is also a character not to be neglected in this connection.

The account of the Stegocephali (including Ganocephala, Rhachitomi, and Embolomeri) is the most complete ever placed in the hands of students; in fact it is the *only* synopsis yet published. In the midst of this important monograph we are compelled to make two corrections. The lettering of the pelvis of Eryops (p. 364) is reversed in position. Secondly, the genus Stereorhachis Gaudry (p. 398) is not a Bratachian, but a reptile of the order Theromora, and probably of the family Clepsydropidæ.—*E. D. Cope.*

Schlosser on Carnivora.[1]—The second part of Dr. Schlosser's important memoir includes the lower Carnivora, or the Ursidæ, Canidæ, and Mustelidæ. It includes much that is new on the subject, and by its thoroughness and critical character advances our knowledge of the European forms much beyond any previous publication. A number of new genera are added, as Pachycynodon in Canidæ; Pseudamphicyon in Ursidæ; and in Mustelidæ, Plesiocyon, Haplogale, Stenogale, and Pseudictis. He includes in the latter family Proælurus Filh. and denies that it is allied to the Nimnavidæ or Felidæ. He redefines the Ursidæ (under the name Amphicyonidæ), so as to include besides Ursus and Hyænarctos,—

[1] Die Affen, Lemur, Chiropteren, Insectivoren, Marsupialia, Creodonten u. Carnivoren des Europaischen Tertiärs; von Max Schlosser; 4 Tafeln; 4to. Alfred Hölder, Wien, 1888. II. Abtheilung.

Amphicyon, Dinocyon, Cephalogale, Simocyon, Oligobunis, and probably Enhydrocyon. In the Canidæ, Dr. Schlosser appears to us to admit too many genera; at least we cannot clearly make out generic differences from his descriptions. On the other hand the genera of Mustelidæ, though numerous, are sharply defined. We note a couple of errors in the matter of American species. *Canis brachypus* Cope is not an Eocene, but an upper Miocene species (Ticholeptus beds). *Aelurodon ferox* and *Canis saevus* cannot be well referred to different families, as they were established on the superior and inferior molars of the same species. Four plates accompany this memoir.—*E. D. Cope.*

MINERALOGY AND PETROGRAPHY.[1]

Petrographical News.—There have recently appeared two interesting papers upon the Cortlandt series of eruptive rocks, and the changes they produce in the surrounding mica-schists and limestones. The first paper is by Mr. J. F. Kemp,[2] who reports the results of his examinations of an extension of the series west of Stony Point, N. Y. He finds the eruptives to be of the same general character as those described by Dr. Williams,[3] from near Peekskill. In one of these he notices the alteration of brown hornblende into green augite. He further finds that limestone upon the contact with these eruptives has undergone an alteration, during the course of which tremolite has been developed. Dr. Williams's[4] paper deals with the contact phenomena observed in the rocks surrounding the eruptives in the Stony Point region. The unaltered mica-schists consist of quartz, biotite, muscovite, a little feldspar, tourmaline, and occasionally zircon. Upon approaching the eruptives they lose their foliation and have developed in them: garnet, sillimanite, staurolite, scapolite, cyanite, margarite, ripidolite and corundum. The *sillimanite* is found in radiating bundles of fibres. The *ripidolite* (or clinoclor) is derived from the biotite of the schists. The *margarite* has the macroscopic appearance of muscovite. In the thin section, it is distinguished from this mineral by its high refractive index, its extinction of 6°–10°, its numerous twins parallel to oP, and its large optical angle (114½° in air). Its composition is:—

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.
[2] Amer. Jour. Sci., Oct., 1888, p. 247.
[3] Cf. Amer. Naturalist, 1886, p. 275; 1887, p. 569.
[4] Amer. Jour. Sci., Oct., 1888, p. 254.

SiO_2	Al_2O_3	FeO	CaO	MgO	H_2O
32.73	46.58	5.12	11.04	1.00	4.49

The paper contains many points of interest, and is a final, incontrovertible proof of the eruptive character of the massive rocks of the Cortlandt series.—In a paper in which the origin of quartz in basalts is discussed, Mr. Iddings[1] describes the microscopic appearance of quartz-bearing basalts from the Rio Grande cañon in New Mexico. Most of these are holocrystalline. They contain plagioclase, augite, magnetite, olivine and rounded quartzes. The quartz is usually surrounded by shells composed of little augite crystals, which extend out into the body of the rock, and are sometimes partly included within the feldspar. It has the characteristics of the porphyritic crystals of more acid volcanic rocks, and is regarded as original. The main portion of the paper is taken up with the discussion of the conditions under which the production of porphyritic quartz crystals might take place in a rock as basic as basalt. After a thorough examination into the effects which temperature, pressure, and the presence of water vapor exert upon the crystallization of a molten magma, Mr. Iddings concludes that the quartzes owe their origin to certain physical conditions attending an early period of the magma's existence; and that of these the most important is the presence of water vapor under pressure. In the same paper the writer describes two new occurrences of quartz basalt. The first is a red compact rock from the vicinity of Santa Maria Basin, in Arizona. The second is a dark-colored, fine-grained rock from the S. E. base of Anita Peak, Colorado.—Kroustchoff[2] has recently described an inclusion in the basalt from Wingendorf, in Silesia, which differs from most basalt inclusions in that it contains anorthite. This mineral and enstatite make up the larger part of the inclusion, which contains in addition to these, augite, diallage, olivine and various spinels. The *enstatite* was separated and analyzed:—

SiO_2	Al_2O_3	FeO	MgO	CaO	Alkalies	Loss
56.96	.79	3.11	33.65	4.32	tr.	.26

—A coarse-grained pyroxene-syenite,[3] from near Gröbe, in Saxony, is composed of orthoclase, plagioclase, augite and biotite, with some quartz and hypersthene. The orthoclase occurs in porphyritic crystals, while the plagioclase is found only in the ground mass. In finer grained streaks throughout the rock the augite has all been replaced by hornblende.—In an article on Mount Lupara, a crater in the Flagraian Fields, near Naples, Deecke[4] describes augite-

[1] Amer. Jour. Sci., Sept., 1888, p. 208.
[2] Min. u. Petrog. Mitth., x., 1887, p. 329.
[3] Klemm: Zeits. d. deutsch. geol. Gesell., xl., 1888, p. 184.
[4] Ib., xl., p. 166.

trachyte and augite-trachyte glasses, which present no features different from those observed in the lavas of other craters in this region.—Mr. E. O. Hovey[1] reports the discovery of a cordierite gneiss at Guilford, sixteen miles east of New Haven, Conn. The cordierite has a deep blue color in the hand specimen, but under the microscope is colorless and very fresh. It contains as inclusions only sillimanite needles.—Lacroix and Baret[2] mention a pyroxenite from near Saint Nazaire, Loire-Inférieure, France, that is composed essentially of a granular mixture of augite, scapolite and sphene.—The microscopical examination and the determination of some of the physical constants of several sandstones, a marble and a tufa from California, have been made by Prof. A. W. Jackson,[3] of the University of California.

New Minerals — Hohmannite and Amarantite.—In a mass of copiapite from near Caracoles, in Chili, Frenzel[4] has discovered two new iron sulphates. One has been called *hohmannite* after its discoverer. This is an opaque chestnut-brown fibrous mineral, with a vitreous lustre. Its hardness is 3; specific gravity, 2.24, and its streak a yellow ochre color. Its composition may be represented by $Fe(FeO)(SO_4)_2 + 7H_2O$. It is insoluble in water, readily undergoes alteration, and loses 7.63 per cent. of water when placed in a dessicator over calcium chloride. The second mineral, *amarantite*, is probably identical with the first, although the author prefers to designate it by a separate name because of its different physical and chemical properties. Amarantite occurs in orange-colored microscopic crystals of the triclinic system.[5] They have a citron-yellow streak, and a specific gravity of 2.11, and do not as readily undergo decomposition as does hohmannite.—*Riebeckite.* In a flesh-red granite from the Island of Socotro, in the Indian Ocean, a hundred and fifty miles from Cape Gardafui, Sauer[6] has found a hornblende which corresponds exactly to aegerine among the augites. Its negative bisectrix (instead of positive as in the other hornblendes) is inclined 5° to the vertical axis, its pleochroism is vr = dark blue; t = green; pi = blue, and its composition :—

SiO_2	Fe_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O
50.01	28.30	9.87	.63	.34	1.32	8.79	.72

Sauer calls attention to the fact, so often overlooked, that the formula of *arfvedsonite*, which is usually regarded as equivalent to aegerine, is based upon an analysis which is really that of aegerine

[1] Amer. Jour. Sci., July, 1888, p. 57.
[2] Bul. Soc. Franç. d. Min. x., p. 288.
[3] Seventh Ann. Rep. State Mineralogist, Sacramento, 1888, p. 205.
[4] Min. u. Petrog. Mitth., ix., 1888, pp. 397, 423.
[5] Wülfing: ib., p. 401.
[6] Zeits. d. deutsch. geol. Gesell., 1888, xl., p. 138.

itself.—*Beryllonite.* In a preliminary note Prof. E. S. Dana[1] suggests the name *beryllonite* for a mineral with the composition Na Be Po_4, occurring in orthorhombic crystals with a tabular habit, a hardness of 5.5–6, and a specific gravity 2.84. The mineral is colorless or white, and has several perfect cleavages. A full description of its characteristics, as well as of its occurrences, is promised in the near future.—*Edisonite*—a fourth form of titanic oxide (a fifth form if Mr. Diller's[2] mineral is found to consist of TiO_2)—is described by Mr. Hidden[3] from the concentrates of placer washings in Polk county, N. C., and at Pilot Mountain, Burke county, in the same State. It crystallizes in the orthorhombic system like *brookite*, but its axial ratio, as calculated by Des Cloizeaux, is .99275 : 1 : .92337. The color of the mineral is yellow or brown, its hardness about 6, specific gravity 4.285, and streak yellowish white.

Rare Minerals.—*Bertrandite.* Heretofore this mineral has been found only in small crystals at various localities in Europe, and its crystallographic characteristics have not been thoroughly investigated. A new find at Mt. Antero, Colorado, affords Mr. Penfield[4] a crystal of sufficient size to admit of exact measurements of the crystallographic constants. According to Mr. Penfield, the mineral is orthorhombic with $a : b : c = .5723 : 1 : .5953$, and $2H = 101° 10'$ for yellow light. The hemimorphic development of the basal plane cannot be explained. The crystals are attached to quartz, and are associated with phenacite, orthoclase, muscovite and fluorite. They have a hardness of 6–7, a specific gravity of 2.598, and consist of:—

SiO_2	BeO	CaO	H_2O
51.8	39.6	1.0	8.4

Piedmontite. The optical properties of the manganese epidote piedmontite have recently been very carefully studied by Dr. Kotô,[5] of Japan, who finds it quite wide spread as a constituent of Japanese rocks. In a piedmontite-schist consisting of quartz, piedmontite, muscovite, garnet, rutile, feldspar, etc., the piedmontite is well crystallized with oP, $\infty \bar{P}\overline{\infty}$, $\frac{1}{2} \bar{P}\overline{\infty}$, P, and $\bar{P}\overline{\infty}$ predominating. The mineral has an extinction of 3°, and is pleochrois as follows: vr = deep reddish violet; t = brownish red; pi = light violet. The absorption is vr > t > pi, whereas in common epidote it is t > pi > vr. An analysis yielded:—

SiO_2	Al_2O_3	Fe_2O_3	Mn_2O_3	CaO	MgO	K_2O	Na_2O	H_2O
36.16	22.52	9.33	6.43	22.05	.40	tr.	.44	3.20

[1] Amer. Jour. Sci., Oct., 1888, p. 290.
[2] Cf. Amer. Naturalist, Feb., 1888, p. 169.
[3] Amer. Jour. Sci., 1888, Oct., p. 272.
[4] Ib., July, p. 52.
[5] Quart. Jour. Geol. Soc., Aug., 1887, p. 474.

The same mineral is an accessory constituent of a glaucophane rock from Japan. It has recently been described, by Haworth,[1] as occurring in a porphyrite from Missouri, and is also mentioned by Lacroix[2] as existing in the mica-schists of the Island of Groix, off the coast of France.—*Emmonsite.* Near Brixlegg, in the Unterinnethal, is a mineral, occurring in little spherical groups of crystals implanted on barite. Its analysis gave 86.89 per cent. of $SrCO_3$, and 13.14 per cent. of $CaCO_3$, thus agreeing very closely with Thomson's *emmonsite* from Massachusetts. Cathrein[3] has measured the crystals, and found them to consist of rhombic prisms with $a : b : c = .6090 : 1 : .7236$.—*Diamonds and Sapphires.* A new discovery of diamonds and sapphires is reported[4] from Australia. The location where they have been found is Invere, New South Wales. They are found in a sand made up of quartz and tourmaline, and pieces of a rock composed of the same minerals.—*Leucite.* Prof. Judd[5] announces the discovery of leucite by Mr. T. W. E. David in a leucite-basalt from Byrock, N. S. Wales, Australia, about 450 miles N. W. from Sydney. Leucite, which until a few years ago was not known outside of Europe, is now known to occur in each one of the continents with the exception of Africa.—*Cryptolite,* the rare cerium phosphate, according to Mallard,[6] is nothing but *monazite* with a habit differing slightly from that which this mineral usually affects.—*Gadolinite* has been found, by Lacroix,[7] in a cavity in the granitite of the Mourne Mountains, Ireland, and *allanite* has been discovered, by Levy and Lacroix,[8] in a granite from Pont Paul, Finistère.

Crystallographic News.—In the course of an investigation of minerals from the Tyrol, Cathrein[9] detected in them several new planes. On a yellow-brown *garnet,* from Rothenkopf, $\frac{8}{3} O \frac{8}{5}$ was found. This form is especially interesting, because it is not only new to garnet, but also to the entire regular system. The new triakistetrahedron—$\frac{\frac{17}{9} O \frac{17}{9}}{2}$ occurs on *tetrahedrite* from Kogel, near Brixlegg; $\frac{39}{38} \bar{P}\bar{\infty}$, $\infty \bar{P}2$ and $\frac{1}{7} P\breve{\infty}$ on *adularia* from Schwarzenstein; and $\bar{P}\bar{\infty}$ on *diaspore* from Grenier.—In an elaborate paper on the crystallography of *dolomite* Becke[10] announces the dis-

[1] Amer. Naturalist, Aug., 1888, p. 732.
[2] Bull. d. l. Soc. Franç. d. Min., xi., p. 148.
[3] Zeits. d. Kryst., xiv., p. 366.
[4] Friedel: Bull. Soc. Franç. d. Min., xl., p. 64.
[5] Geol. Magazine, May, 1888, p. 193.
[6] Bull. Soc. Franç. d. Min., x., p. 236.
[7] Ib., xi., p. 68.
[8] Ib., xi., p. 65.
[9] Min. u. Petrog. Mitth., x., p. 52.
[10] Ib., x., p. 73.

covery of the new forms $+\frac{r}{l}\frac{\infty R3}{2}, + \frac{r}{l}\frac{4R3}{2}, - \frac{e}{r}\frac{2R3}{2}, - \frac{l}{r}\frac{R\frac{13}{3}}{2}, - \frac{l}{r}\frac{8R3}{2}, + \frac{l}{r}\frac{4R3}{2}, + \frac{l}{r}\frac{\infty R3}{2}$. As indicated by these formulas, Becke finds dolomite to be rhombohedrally tetrahedral. In addition to the full lists of forms occurring on the mineral, there is in the paper a full discussion of its vicinal planes. —*Pyrite*[1] crystals from the clay slates near Trofajach in Steiermark, contain the new plane $\frac{\infty O 6}{2}$. Michel[2] claims that crystals of the selenates of barium, strontium, calcium and lead are isomorphous with the natural sulphates of the corresponding metals.

MISCELLANEOUS.—Prof. Judd[3] has recently demonstrated in a very interesting paper that quartz may have secondarily developed in it a lamellar structure analogous to that which is so frequently produced in feldspar by pressure. The lamellæ in quartz are best brought out by etching. By studying the images reflected from the etched surfaces, Judd discovered that lamellæ existed only where the crystal examined had suffered injury; that the lamellæ were parallel to R and —R, which may be regarded as gliding planes; and finally that the change produced in the internal structure of the quartz consisted in a change in the nature of the circular polarization of the alternate lamellæ, and not in such a change as takes place in the development of twinning lamellæ in calcite and feldspar. It is thought that the planes along which a quartz crystal breaks when heated and suddenly cooled may be these gliding planes.—Prof. Crosby[4] discusses the origin of the silica that is often found cementing the grains in a sandstone, and suggests that it might result from the solution of siliceous organisms, which are everywhere abundant in the waters of the oceans, and may with some probability be assumed as occurring in the waters in which the sandstones were deposited.—Dr. E. A. Schneider[5] urges the importance of studying the effect of acids (especially hydrochloric) upon silicates, with the view of determining their constitution in a manner analogous to that so frequently made use of in organic chemistry for the purpose of determining the nature of the inner structure of carbonaceous substances.—Becke[6] proposes a method for distinguishing between quartz and feldspar in rock sections. It depends upon the fact that the former mineral is entirely dissolved by hydrofluoric acid, while the latter yields an amorphous aluminium fluosilicate, which can be stained with a solution of some aniline color.

[1] Hoefer: Ib., x., p. 157.
[2] Bull. d. l. Soc. Franç. d. Min., xi., p. 182.
[3] Miner. Magazine, 1888, p. 1.
[4] Technology Quarterly, May, 1888, p. 397.
[5] Amer. Chem. Jour., x., p. 405.
[6] Min. u. Petrog. Mitth., x., p. 89.

BOTANY.[1]

The So-Called "Resurrection Plant."—M. Leclerc du Sablon describes (*Bull. Soc. Bot. France*, xxxv.) the curious property of revivification possessed by *Selaginella lepidophylla*. When the root withers, each branch curls up, and the plant appears more or less in the form of a ball. In this state it is able to remain for a long time, and then when the water necessary for its growth is supplied, the branches unroll, the green color which had almost disappeared returns, and the branches and roots re-commence to grow. The structure of the plant is such that when dehydration occurs, the cells on one side of a branch are thicker than those on the other, thus they contract unequally and cause the branch to curl up.—*Jour. Roy. Mic. Soc., Vug., 1888.*

Pediastrum and Polyedrium.—Most botanists have had specimens of various species of both these genera under observation, and probably few have suspected their real relationship. The flat discs of the former certainly bear little resemblance to the caltrop-shaped groups of pointed cells of the latter. However, it appears that Askenasy has demonstrated that Polyedrium is but a stage of Pediastrum, or, to be more accurate, in statement, that *Polyedrium polymorphum* is a stage of *Pediastrum boryanum*.

The Plants of Rhode Island.—James L. Bennett, of Providence, has prepared, and the Franklin Society has printed, a catalogue of the plants of Rhode Island, enumerating 2,928 species, besides 230 varieties. They are distributed as follows:—

Phanerogams..........	475 genera,	1,259 species,	101 varieties.
Cryptogams............	494 "	1,669 "	129 "

Of the phanerogamous orders the following are the richest in species: Compositæ, 152; Cyperaceæ, 131; Gramineæ, 126; Leguminosæ, 52; Rosaceæ, 41; Labiatæ, 37; Scrophulariaceæ, 35; Ericaceæ, 32; Cruciferæ, 29; Ranunculaceæ, 28; Polygonaceæ, 28; Caryophyllaceæ, 27; Umbelliferæ, 27; Liliaceæ, 25.

The Cryptogams are represented as follows, viz.: Equisetaceæ, 4 species; Filices, 33; Lycopodiaceæ, 13; Characeæ, 8; Musci, 185; Hepaticæ, 74; Lichenes, 151; Fungi, 582; Algæ, 619.

The work of preparation has evidently extended over a considerable period, as in the preface it is stated that the Musci were determined by Mr. Lesquereux, and the Hepaticæ passed through the hands of Austin, who also aided in the determination of Musci,

[1] Edited by Prof. Chas. E. Bessey, Lincoln, Neb.

as did, also, Tuckerman for the Lichenes, and M. A. Curtis and Berkeley for the Fungi. The two groups last named were revised by Willey (Lichenes), and Peck and Ellis (Fungi).

The arrangement of the Phanerogams follows that of Bentham and Hooker, but that of the Cryptogams is in confusion, and is decidedly antiquated, particularly so in the Fungi. However, the list is a very useful one, and a credit to author.

Watson's Contributions to North American Botany, XV.—In this contribution the new cruciferous genus Lesquerella is described. It includes American species hitherto referred to Vesicaria, and Alyssum, with a few species here described for the first time, making thirty-three in all. A revision of the North American species of Draba is given, including descriptions of two new species. Thirty-two species are recognized.

Among the more notable new species described may be noted—a Trifolium (*T. howellii*) from southern Oregon; a Pyrus (*P. occidentalis*) from Washington Territory to California; a Pentstemon (*P. shockleyi*) from Nevada; a Calochortus (*C. howellii*) from Oregon; and a Tillandsia (*T. wilsoni*) from Florida. A new genus of Eupatoriaceæ is described under the name Hartwrightia, represented by a single species (*H. floridana*) from Florida. Both genus and species are credited to Dr. Gray, who recognized them as distinct, but delayed publication in order to await better material.

Many interesting species of Mexican and Guatemalan plants are described in Parts 2 and 3 of the paper. Prionosciadium, near Angelica in Umbelliferæ, and Louteridium in Acanthaceæ, are the two new genera described, the first represented by three Mexican, and the second by one Guatemalan species, the latter bearing the highly objectionable name of *L. donnell-smithii.*

Canadian Plants.—Part IV. of the Catalogue of Canadian Plants, by John Macoun, completes the list of flowering plants. The list includes 2,955 species. Two more parts are still to appear; Part V. to be devoted to the ferns and their allies, and the mosses and liverworts; and Part VI. to lichens, fungi and algæ.

Engelmann's Botanical Works.[1]—When Dr. George Engelmann died, in 1884, his botanical writings were scattered through the pages of so many publications as to make much of his work inaccessible to the ordinary student. This has been remedied by Henry Shaw, the well-known philanthropist of St. Louis, through whose liberality the scattered writings have been brought together

[1] The Botanical Works of the late George Engelmann. Collected for Henry Shaw Esq. Edited by William Trelease and Asa Gray. Cambridge, Mass.: John Wilson & Son, University Press, 1887. 4to.

in a handsome quarto volume of 548 pages, and nearly one hundred full-page plates.

The title-page bears the names of William Trelease and Asa Gray, as editors. In the preface, which bears date of March, 1887, Dr. Gray states that "the classification and arrangement of the papers, and essentially the whole editorial labor, has devolved upon the Engelmann Professor in the Shaw School of Botany, Dr. Trelease, under my supervision." The biographical sketch which appears in the volume is the same as that prepared for the American Academy of Arts and Sciences by Dr. Gray, and afterwards published in the Proceedings of the Academy, and also in the *American Journal of Science.*

The contents of the volume may be summarized as follows: 1. De Antholysi Prodromus (a Latin dissertation on Teratology). 2. Sketch of the Botany of Dr. A. Wislizenus's Expedition (from Missouri to Santa Fé). 3. Papers on Cuscutineæ (six in all). 4. Papers on Cactaceæ (twelve in number). 5. Papers on Juncus (two). 6. Papers on Yucca, Agave, etc. (eight). 7. Papers on Coniferæ (twelve). 8. Papers on American Oaks (four). 9. Papers on Vitis (six). 10. Papers on Euphorbiaceæ (six). 11. Papers on Isoetes (three). 12. Shorter miscellaneous papers (eleven). 13. Lists, and collected Descriptions of Plants (ten). 14. General Notes (three).

The engravings which illustrate the papers were in some cases printed from the original plates, while in others new plates had to be made, the originals having long since been destroyed. The volume is a most valuable one, and reflects great credit upon all concerned in its production.—*Charles E. Bessey.*

Algæ Growing on Animals.—Three species of algæ, belonging to two genera, have been recently described as occurring on the hairs of Sloths. The green species is placed in the new genus *Tricophilus* in the family Chroolepideæ, and the violet ones in the genus *Cyanoderma*, also new, of the family Chamæsiphoneæ. It has been estimated that as many as 150,000 to 200,000 individuals often occur upon a single hair.

The Use of Tannin in the Plant.—The suggestion has recently been made by Professor Hillhouse that tannin may be developed in plants as a protection against the attacks of fungi.

Ravenel's Herbarium.—This valuable collection is offered for sale by the widow of the late H. W. Ravenel, at Aiken, S. C. It should be secured by some college, and given a permanent home where it may always be accessible to students of the fungi.

ZOOLOGY.

A PROBABLE CASE OF INSTINCT AT FAULT IN BEES.—While staying for a day at a ranch in the valley of South Platte, in Colorado, a few years ago, I found some excellent honey served upon the ranchman's table. He informed me that he had undertaken to keep bees, but that he had lately had "bad luck" with them, which were new swarms that he had only the year before brought from his former home in Illinois; and he gave me the following account of his experience with them. He said that upon the appearance of flowers in the spring his bees became very active and quickly filled with honey not only the main hives, but all the accessory boxes which he attached to them. The comb was clean and perfect and the honey good. In the midst of the season of abundant flowers he observed that his bees began to diminish in numbers, and while flowers were yet abundant his hives became well nigh depopulated, and few or no new swarms were ever produced. Upon opening some of the forsaken hives he found them filled with comb, nearly or quite every cell of which was filled with honey. The hives seemed to be in excellent condition, and he found no trace of the presence of any enemy of the bees.

I examined one of the opened hives, which yet contained a portion of the honey in its comb, and so far as I could see, its condition entirely agreed with the ranchman's statements. I also observed that his hives had been placed in the midst of many acres which were mostly covered with a natural and luxurious growth of the plant *Clione integrifolia* Torrey & Gray, from the flowers of which the bees had evidently obtained their honey.

I am well aware that the foregoing statements as they were made to me, even when supplemented with such personal observations as I was able to make, are not sufficient to base a scientific conclusion upon; but accepting the statements as true, I offer the following suggestions as probably indicating the cause of the rapid extinction of those bees under circumstances that were apparently the most favorable for their preservation and increase.

The plant upon which the bees worked, *Clione integrifolia,* flowers abundantly and continuously through several months of spring and summer. The flowers are so laden with nectar that one plainly tastes it upon plucking the corollas and sucking the tubes. The distance from the abundant flowers to the hives was so short that the bees could obtain the honey with remarkably little labor.

Packard states that the life of working bees of the first brood of the season is about six weeks. Some apiarists think that during the season of most active labor the life of those bees does not exceed

a month. May it not, therefore, have been the case that the workers to which fell the task of collecting honey brought it in such quantities and, so quickly, that all the comb-cells were filled before the queen had an opportunity to deposit her eggs? If this were the case the swarms necessarily became extinct by the natural limitation of the life of individual bees, because of the failure to keep up their numbers by breeding. In short is not this a case in which the instinctive struggle for existence defeated its object?

I have no intention of drawing a parallel between this case of disastrous results to bee-life under apparently normal and unusually favorable conditions, and a certain phase of human society, but if the foregoing suggestions are of little value for want of scientific verification they are believed to be deserving of consideration from other points of view.—*C. A. White.*

THE CALCAREOUS PLATES OF THE STAR-FISH.—Dr. J. W. Fewkes (*Bulletin Mus. Comp. Zool.*, XVII., 1888) describes at length the development of the calcareous plates in Asterias, and compares the results with those furnished by Amphiura. The results of the comparison may be tabulated thus:—

Amphiura.	*Asterias.*
Basals.	Genitals.
Dorso-central.	Dorso-central.
Dorsals.	Dorsals.
Laterals.	Inter-ambulacrals.
Terminals.	Terminals.
"Spoon-shaped plates."	Oral Ambulacrals.
Orals.	First Inter-brachials.
First and second Adambulacrals.	No Homologues.
Ventrals.	No Homologues.
No Homologues.	Dorso-laterals and connectors.

The madreporic opening is placed on two homologically different plates in Amphiura and Asterias.

A NEW EARTHWORM.—Under the name *Diplocardia communis*, H. Garman describes (*Bulletin Ill. State Lab. Nat. Hist.*) a new earthworm from Champaign, Ill. This new genus belongs to the family Acanthodrilidæ of Claus, but it differs from the other members of the family in several important characters. Its nearest relation is Acanthodrilus of Africa and the Orient. Among the most noticeable features are the absence of a sub-neural vessel, the existence of a double dorsal vessel, the two halves being separated throughout their length, except where they pass through the dissipiments between the somites. Although not mentioned by Mr. Garman, this character of the central circulatory organ pos-

sesses considerable morphological interest when taken in connection with the method of formation of the "heart" in many Arthropods, *e.g.*, Branchipus (Claus) and Oecanthus (Ayers). The paper concludes with a valuable catalogue of the known American species of earthworms, which we summarize here:

Family LUMBRICIDÆ.—Genus *Tetragonurus* Eisen, *T. pupa* Eisen.——Genus *Allolobophora* Eisen, *A. bœckii* Eisen, *A. riparia* Hoffmann, *A. fœtida* Savigny, *A. subrubicunda* Eisen, *A. mucosa* Eisen, *A. turgida* Eisen, *A. tenuis* Eisen, *A. tumida* Eisen, *A. parva* Eisen, *A. nordenskioldii* Eisen.——Genus *Lumbricus* Linné, *L. herculeus* Sav., *L. rubellus* Hoffmann, *L. purpureus* Eisen.

Family ACANTHODRILIDÆ.—Genus *Diplocardia* Garman, *D. communis* Garman.

Family PLUTELLIDÆ.—Genus *Plutellus* Perrier, *C. heteroporus* Perrier.

Family PERICHÆTIDÆ.—Genus *Perichæta.* Mr. Garman states that an undetermined species of this oriental genus has been acclimatized in the green houses at Champaign, Ill.

ISOPOD ANATOMY.—B. Rosenstadt (*Biol. Centralbl.* VIII., 452, 1888) describes many points in the anatomy of *Asellus aquaticus* and other Isopods. Besides concise accounts of the vascular, nervous, and digestive systems, the author mentions the existence of a rudimentary antennal gland similar to that found in Apseudes and Praniza. In Asellus he found in addition a convoluted canal on either side of the "stomach," which resembled the "shell-gland" of the Entomostraca. The opening of the gland occurred at the base of the second maxilla, and its lumen contained concretions of urates (so shown by Murexide test); points which demonstrated its homology with the shell-gland of the Entomostraca. This is its first recognition in the Malacostraca, though the author found it later in Porcellio, Idotea, Nesæa, Cymothoa, and Jæra.

THE LARVA OF PROTEUS.—Dr. Ernst Zeller has been so fortunate as to have a *Proteus anguineus* lay seventy-six eggs in captivity, from which in ninety days two larvæ hatched. According to his description in the *Zoologischer Anzeiger* (Bd. XI., p. 570, 1888), the larvæ when hatched were more developed than is the case in Amblystoma and the "Axolotl," and measured 22 mm. in length, of which five belonged to the tail. The general appearance was much like that of the adult. The pale red gills are shorter and less developed than in the adult; the anterior limbs are well developed and three-toed, but the hinder pair are still stump-like. The development of the small black eyes is noticeable, as is also the development of pigment in various regions of the body. A few points are mentioned concerning the embryonic

development, and of the larvæ for two weeks after development, when they possessed two toes to the hind feet.

The Nest and Eggs of the Alligator.—Dr. S. F. Clarke thus describes the eggs of the alligator in a recent number of the *Zoologischer Anzeiger*. The eggs and young alligators are such common objects in the shop windows in many of the Southern States, that it appeared to be a simple matter to secure the eggs at the right time and in abundance. It proved, on the contrary, to be very difficult. I was assured by various hunters in Florida that each month from January to September inclusive, was the only month in which the alligators lay their eggs, and this resulted in my having to make two journeys of over twenty-six hundred miles each.

At the time of my first visit, the first week in April, all eggs had been laid, and the ovaries of adult female alligators were full of eggs of all sizes up to 26 mm. in diameter. I returned to Florida June 4th, and found that I was still somewhat early, as the nests were then being built. With the aid of five experienced hunters I at last succeeded in finding, on the 9th of June, a nest, evidently just completed, in which there were twenty-nine eggs. The next day, at a point forty miles further north, a second nest was found with thirty-one eggs. There were many nests found, old and new, but only these two contained eggs.

The nests vary much in size, the largest being about 2½ metres in diameter at the base, and 80 cm. high in the central part, the whole having the shape of a rounded cone. They are located generally on a slightly elevated place, which is higher by a metre, or slightly more than the surrounding level, and covered with a thick growth of palmettos, mangroves, magnolias, etc. These are called "hummocks" by the natives. On one side of the hummock at least, in some cases on all sides, is a pond from one to two metres in depth, and in the bank, under water, the female alligator digs a cave, which in some cases extends three metres under the hummock, and which is always close to her nest. The nest is made by scratching together a great pile of dead leaves and twigs and humus which forms the surface of the ground, and which is arranged with some care. The inside is made of the more finely divided—almost powdery—material of the deeper layers of the top soil, while the outside, even to the top, is covered with twigs and leaves which are whole or but little broken, and with many of the long, unbroken leaves or needles of the southern pine. The eggs are deposited about 20 cm. from the top, and in the nests were found lying on top of one another, making rows or layers, with the fine humus filling all the interstices. The top of the nest is always exposed to the sun.

Dr. Clarke describes the eggs as very difficult to manipulate, as

the shell membrane is tough, and the white very sticky. Before studying his eggs he took them to Williamstown, Mass., but before arriving there they had undergone a part of their development, and the neural folds had nearly completed their coalescence.

Anatomy of Birds.—Mr. F. E. Beddard (*P. Z. S.*, London, 1888) gives an account of the alimentary tract and syrinx of *Balœniceps rex,* from which, and from the previously known osteological peculiarities, he regards this bird, "in fact, as a rather aberrant heron, having no near affinities with the storks, nor to Scopus." In the same volume he has some notes on the visceral anatomy of the penguins and puffins, dealing especially with the oblique septum of these birds, and the morphological and taxonomic conclusions to be drawn therefrom. He is inclined to homologize it in details with a fibrous and even muscular structure found in the crocodile. Dr. R. W. Schufeldt (*Jour. Comp. Anat. and Surgery,* October, 1888) gives a much needed account of the osteology of the Jungle-fowl, *Gallus bankiva.* He also treats of several other important structures in the same bird, which is of especial interest as being the ancestor of all of our domestic fowl. Some thirty process figures illustrate the chief points in the article.

ENTOMOLOGY.[1]

Color-relations between Pupæ and their Surroundings.—Students of Lepidoptera often observe variations in the color of different pupæ of the same species, that have apparently been caused by the color of the object to which the pupa is attached. Striking instances of these variations came under the observation of the writer during the past summer, when breeding *Papilio asterias.* Pupæ attached to green leaves were bright green in color, while others attached to the sides of a breeding-cage closely resembled in color the wood upon which they were.

This class of phenomena has been made the subject of careful study by several English entomologists. The more important of the papers published are two in number. The first, by Mr. E. B. Poulton,[2] was read before the Royal Society of London last year. Since that time Mr. George C. Griffiths has carried the matter farther, and the results of his experiments have just been published by Mr. William White.[3]

[1] This Department is edited by Prof. J. H. Comstock, Cornell University, Ithaca, N. Y., to whom communications, books for notice, etc., should be sent.

[2] Philosophical Transactions, Vol. clxxviii., B., 1887, pp. 311–441.

[3] Trans. Entomol. Soc., London, 1888, pp. 247–267.

Previous to these writings, observers had freely stated that it was the habit of chrysalides to assume the precise coloration of the surface to which they were attached, and the untested facts of the case had been considerably exaggerated. In explanation of the phenomena in question, the earlier writers held that these correspondences of color were analogous to those of the Chameleon, or that they were photographic. Attention was called to the transparent surface of the freshly formed pupa, which might be sensitive to light. Professor Meldola, however, had modified such statements by declaring [1] that "the action of light upon the sensitive skin of a pupa had no analogy with its action on any known photographic chemical. No known substance retained permanently the color reflected on it by adjacent objects."

This represents the state of our knowledge at the time of the publication of Mr. Poulton's memoir. In this paper the results of many experiments are tabulated. Some of them are very striking. Thus, in the case of pupæ of *Vanessa*, exposed to gilded surroundings, many of them appeared as if they had been covered with gold leaf. This memoir is a difficult one to abstract, owing to the great amount of details. The following appear to be the more important conclusions:—

1. There is a great difference with regards to the sensitiveness of different species. Thus he proves that the pupæ of the following named butterflies possess an adjustable color-relation to their surroundings: *Vanessa io, V. urticæ, V. atalanta, Pieris brassicæ,* and *P. rapæ,* while, on the other hand, dimorphic pupæ, which are closely allied to the sensitive forms, may be uninfluenced by surrounding colors, *e.g.: Papilio machaon* and *P. polydamus.* In the genus Ephyra (Heterocera) the dimorphic pupæ are quite uninfluenced by their surroundings, the pupal colors corresponding to those of the dimorphic larvæ.

2. The previously accepted theory, which explained the pupal color-relation as following from the action of light upon the moist skin of the freshly-formed pupa, is entirely disproved, and it is shown that the influence works upon the larva during the period which intervenes between the cessation of feeding and pupation. This intervening period was carefully investigated in *V. urticæ,* and it was found that, after ceasing to feed, the larvæ wander for a variable time, then rest for about fifteen hours upon the surface selected for pupation, and finally hang suspended, head downwards, for about eighteen hours, after which time pupation takes place. By transferring the larvæ from one color to another, it was found that the color influence works for about twenty hours preceding the last twelve hours of the whole period.

[1] Proc. Entom. Soc., London, 1874, p. XXIV.

3. Blinding proved that the eyes do not form the organs which are influenced, and it was also shown that the complex bristles do not contain a terminal organ with this function. Experiments with conflicting colors appear to prove that surrounding colors affect the whole surface of the larval skin, although parti-colored pupæ were not obtained. (There is, however, some evidence of such a result in *Papilio nireus*.)

4. In all cases there are certain colors which produce no effects. In Vanessa the brilliant metallic tints of the pupæ can be greatly influenced by the presence of gilded surfaces in the environment of the larva before pupation. This fact appears to prove that the metallic tints are essentially protective, and probably subserve concealment by their resemblance to glittering minerals, such as mica. This theory is confirmed by observations upon the habits of certain species with gilded pupæ. At the same time the gilded appearance has acquired another and opposite significance in other species, being of use in rendering the pupæ conspicuous, and thus acting as a signal of an unpleasant taste or smell.

5. The amount of pigment in the superficial layer of the cuticle in the pupæ of *Pieris brassicæ* and *P. rapæ* appears to be influenced by the spectroscopic composition of the light incident upon the larvæ before pupation.

The experiments of Mr. Griffiths, as summarised by Mr. White, confirms Mr. Poulton's observations in the following particulars: (1) Dark surroundings exercise a retarding influence upon the period before pupation. (2) The freshly-formed pupa is *not* photographically sensitive, but the period during which the larva rests motionless upon the selected surface is the time of chief susceptibility. (3) The general results of the colors themselves also entirely confirm Poulton's observations, notably in the case of dark pupæ produced by black, and of green pupæ produced by yellow. (4) The special effects of yellow surroundings in arresting the formation of dark superficial pigment, and in tending towards the production of green pupæ, were very striking, and confirm Poulton's suggestion that rays from this part of the spectrum, when predominant in the light incident upon the susceptible larva, determine the production of these results whenever green pupæ are produced by the influence of surroundings. When green pupæ of Pieris are produced, as in nature, on green leaves, it is probable that the effect is wholly due to the reflected yellow rays. Though these experiments do not exactly furnish materials for new conclusions, they are valuable as independent corroborations of Poulton's results.

Serious Injury to Apples by the Plum Curculio.—During the latter part of the past summer my attention was

attracted to a serious injury done to the fruit in an apple-orchard through which I passed daily. A large proportion of the apples in one corner of the orchard had been eaten into by something which made small pits from one-eighth to one-fourth inch in diameter, and of about the same depth. On one tree nearly every apple had been attacked, and in many cases there were ten or twelve holes in a single apple. The injury was so serious as to render the fruit in this part of the orchard unmarketable.

The holes in the apples were first observed during the latter part of August. At that time many of them were partially grown over, while others were fresh, indicating that the pest had been at work for a considerable time, and was still active. As the injury to the apples resemble somewhat that caused by a climbing cut-worm, that sometimes infests apples in western New York, I at first searched for caterpillars, and gave little thought to the plum curculios that I frequently found hiding in the pits in the apples. But, after finding a considerable number of these insects in these pits, it occurred to me that they might be the cause of the mischief. Several perfect apples were then selected and placed in breeding-cages, in each of which were confined several curculios. The question was soon settled. Within twenty-four hours the beetles had begun to eat into the apples. They made small holes at first, but these were soon enlarged so as to form pits of the size indicated above.

The results of this experiment are of special interest at this time as confirming the observations referred to in the next note.—*J. H. Comstock.*

Poisoning the Plum Curculio.—In referring to some experiments made by me to prevent curculio injuries, in the August Naturalist, the question is raised as to how spraying with poisons may have a preventive effect on this insect. I believe that a satisfactory explanation may now be given. Early last June I confined an adult curculio in a jar with a large green plum, and was surprised at the avidity with which the fruit was eaten. A large portion of the surface was gnawed out for food, and not for purposes of oviposition, and the feasibility of poisoning the adult beetles by coating the fruit with poison is clearly shown.

But even more satisfactory breeding-cage experiments were made in Illinois, by Professor Forbes, who informs me that he has found that, besides gnawing out the fruit, the adult curculio eats freely of the substances of the leaves. He adds that the curculios "are certainly very freely exposed to destruction by poison, without reference to the habits of oviposition or the first food of the larvæ;" and that he has "also learned experimentally that spraying the leaves with Paris green would poison the beetles completely."

Professor Forbes discussed at some length the details of his experiments, which confirm the conclusions reached in my experiments, in an address delivered at a meeting of the Central Illinois Horticultural Society during last August. (*Prairie Farmer*, August 11, 1888.) Professor A. J. Cook, of the Michigan Agricultural College, also announces, in Bulletin No. XXXIX., similar results.—*Clarence M. Weed, Ohio Agricultural Experiment Station.*

Smith's Monograph of the Sphingidæ of Temperate North America.—Parts II. and III. of the current volume of the *Transactions of the American Entomological Society* are devoted to a "Monograph of the Sphingidæ of Temperate North America," by Mr. John B. Smith. This paper makes a volume of nearly 200 pages. It appears to be very complete, and very carefully written. The synonymy of each species is given; the adult is fully described, and descriptions of the early stages are also given whenever they are known. The work abounds in valuable critical notes. Analytical keys for the separation of genera and of species are furnished. The paper concludes with a synonymical list. Eighty species are enumerated in this list. This work should be in the hands of every student of American Lepidoptera.

EMBRYOLOGY.[1]

Development of Meloe.—Josef Nusbaum describes briefly (*Biol. Centralblat.*, VIII., p. 449-452) the development of the oil beetle, Meloe. This form is very convenient for embryological studies as it breeds well in confinement and lays little piles of eggs, all the eggs in a single pile developing synchronously. The segmentation nucleus is central and the cells resulting from the segmentation migrate slowly to the surface, the protoplasm forming a reticulum in the meshes of which the yolk is embraced. Some of these cells reach the surface to form the blastoderm while others remain behind to form "yolk cells." On the third day the ventral plate and the rudiments of the amnion appear very early the ventral plate becomes segmented, and paired appendages appear on every segment of the body. The primitive groove appears at the same time as the amnion and develops from behind forward. It soon closes and forms a tube with a very narrow lumen behind, in front a solid cellular in-pushing. This is regarded as gastrulation, and the portion thus invaginated as ento-mesoderm or primary entoderm,

[1] Edited by Prof. John A. Ryder, Univ. of Penna., Philadelphia.

from the hinder portion of this cells, are cut off, which wander in and join the "yolk cells," but have nothing to do with the formation of the mesenteron. The remainder of the primary entoderm differentiates into two large lateral and a middle solid longitudinal band, and in the former there appears in each segment a cavity. The outer wall of this cavity forms the somatopleure, the inner the splanchnopleure and epithelium of the digestive tract. This inner wall soon separates completely from the outer in the middle line, and there becomes two-layered, thus developing both entoderm and splanchnopleure. These lateral bands of entoderm now unite with the middle one and soon enclose the whole yolk and the "yolk cells" which latter later degenerate and are absorbed.—*J. S. K.*

MICROSCOPY.[1]

Vital Infusion of Nerves with Methyl-blue.—Prof. Ehrlich's[2] experiments in staining nerves with *methyl-blue*, mark the second great advance in staining *living* tissues. The discovery of a veritable nerve-stain, that acts *intra vitam*, has already led to the settlement of many disputed points, and promises to furnish a means for deciding the problem of nerve-endings. The well-known color-reaction induced in newly formed bone-substance as the result of madder-feeding, is outshone by this wonderful reaction between methyl-blue and the axis-cylinder.

According to Ehrlich two conditions are necessary in order to get the methyl-blue reaction: These are (1) *saturation with oxygen* and (2) *alkaline reaction*. The first condition can be secured only by free exposure of the object to the air. If a cover-slip is used, the air is thus excluded, and the stain rapidly disappears.

As to the second condition, it is known that nerves at rest have an alkaline reaction. It is necessary, therefore, to experiment on *resting* nerves. The state of rest may be forced by severing the nerves before infusion with methyl-blue, or by poisoning the animals with curare. The nerve-endings of the retina may be studied on animals that have been kept some time in the dark before infusion. The number of nerve terminations that stain under ordinary conditions is, however, so great, that a wide field for histological investigation is open to us without having recourse to the expedients just mentioned.

[1] Edited by C. O. Whitman, Director of the Lake Laboratory, Milwaukee.

[2] P. Ehrlich. Ueber die Methylenblaureaction der lebenden Nervensubstanz. Deutsch. med. Wochenschr., 1886, No. 4.

The evanescence of the color-reaction is a serious drawback, but this difficulty has been met with some success by the use of iodine and picro-carmine as "fixing" reagents.

The method of procedure, according to Prof. C. Arnstein,[1] and his pupils, Dogiel and Smirnon, is as follows:—

1. Inject the *vena cutanea magna* of a frog with 1 cc. of a saturated solution of methyl-blue. The tongue and palate are at once colored, but the coloring substance is confined to the blood-vessels, and does not at first affect the nerves. After an hour or two the nerves supplying the taste papillæ appear blue, and at the same time the nerve-meshes of the palate are also stained. The motor nerve-ends show the stain a little later. The color-reaction only lasts a short time, often not more than five to ten minutes. It should be fixed at the moment of its greatest intensity. If iodine is used for this purpose, proceed as follows:—

2. Place the frog in a 1 per cent. aqueous solution of potassic iodide, in which metallic iodine has been dissolved to saturation, and inject the blood-vessels with the same solution, thus freeing them from the blood as far as possible.

3. Next cut out the parts needed and leave them in the iodine solution from six to twelve hours.

4. Transfer to water and leave until most of the iodine has been withdrawn. As the result of this treatment, the nerves will have a dark brown or grey color, and the surrounding tissue will be nearly colorless.

5. Mount in acidified glycerine.

Picro-carmine as a "fixing" agent, is said to give more durable preparations than iodine, but the latter gives the more intense color.

Mammals and birds die soon after injection of methyl-blue, so that a true intra vitam reaction can not be easily obtained. However, a very satisfactory reaction may be obtained, with these animals, after death from chloroform. The injection may be made from the heart or from any blood-vessel. The appearance of color in the nerves can be followed under the microscope, and when its maximum has been reached, the fixing reagent applied.

Finally, with a dilute solution of methyl-blue, preparations can be stained *directly on the slide.* The retina of fishes, birds, and mammals, can be more successfully stained this way than by injection.

Dr. Max Joseph[2] has tested Ehrlich's method on Heteropods and found that the clear intra vitam stain could not be satisfactorily fixed. He remarks that *the commercial methyl-blue is unfit for use,*

[1] Anat. Anz. ii., 1887, No. 5, p. 125, and No. 17, p. 551.
[2] Anat. Anz., June, 1888, No. 15, p. 420.

and that *only the chemically pure article will give the results obtained by Ehrlich.*

Instead of a saturated solution, Dr. Joseph recommends the strength originally employed by Ehrlich,—*one-quarter gram color in 100 grams of the physiological salt solution.*

The best stain was reached about six hours after injection in the body-cavity.

Biedermann[1] has employed nearly the same method for Crustacea and insects.

Central Termination of the Optic Nerve in Vertebrates.[2]—For tracing the course of nerve-fibres, the following method has been employed with great success by Prof. Bellonci.

1. The brain, or a part of it containing the nervus opticus, is placed in osmic acid ($\frac{1}{2}$ to 1 per cent.) for fourteen to twenty hours.

2. Sections are then made with free hand in alcohol of 70 per cent.; the sections are washed in distilled water a few minutes, and then placed in 80 per cent. alcohol three or four hours.

3. The sections are again placed in distilled water, and then transferred to the object-slide, and covered with a cover-slip.

4. A few drops of ammonia are then allowed to mix with the water under the cover-slip. This reagent makes the brain transparent as glass, with exception of the nerve-fibres, which remain black, and which are brought out with such distinctness that their course is easily followed.

The sections are of course thick, but this is an advantage in tracing the winding course of the fibres.

Sections cut in celloidin with the microtome can be treated in same manner, but the action of the ammonia is much slower, requiring several days.

Double-staining of the Central Nervous System.[3]—

1. Of the various fluids used for hardening, a *3 to 4 per cent. solution of bichromate of potassium* gives the best results. The object must be in a fresh condition when placed in the fluid, and the fluid must be changed often during the process of hardening.

2. The sections are best when made, without imbedding in celloidin, from pieces fastened to cork with gum and then placed in alcohol long enough to harden the gum.[4]

[1] Sitzb. d. Kaiz. Akad. d. Wissensch., Vol. xcvi., 3 Abth. 1887.

[2] *Josef Bellonci.* Ueber die centrale Endigung des Nervus opticus bei den Vertebraten.

Zeitschr. f. wiss. Zoologie, xlvii., I., p. 4, September, 1888.

[3] *Hermann Sahli.* Ueber eine neue Doppelfärbung des centralne Nervensystems. Zeitsch. f. wiss. Mikroskopie, ii., I., p. 1, 1885.

[4] Preparations left several days in alcohol can still be used. But the sections should be laid in the bichromate of potassium for an hour, and

3. The sections are placed in water for a few minutes (not over five or ten), and then in a saturated aqueous solution of *methyl-blue* until stained deep blue.

4. They are then washed, and placed in a saturated aqueous solution of acid fuchsin for about five minutes.

5. The sections are next to be quickly washed, and placed for a *few seconds* in an alcoholic solution of caustic potash (1 per cent.), from which they are to be transferred at once to abundant water.

The color differentiation at once appears: The white matter becomes blue or violet, and the gray matter red. Bundles of fibres in longitudinal section appear to be made up partly of blue and partly of red fibres. Cross-sections show that the difference in color among the fibres is due to the presence in varying amount of two unlike substances in the medullary sheaths. These substances may be distinguished as *erythrophilous* (red) and *cyanophilous* (blue). The axis-cylinder is uniformly red, while the medullary sheaths are variegated. In some fibres the whole sheath is made up of cyanophilous matter, in others of erythrophilous matter. In the majority of the fibres, the sheath is composed of concentric layers, blue alternating with red.

In the gray matter of the spinal chord may be seen Gerlach's net-work of fine fibrils. Close examination shows that the fibril is differentiated into red axis-cylinder and blue medullary sheath.

Preparations after the above method are not permanent, but they sometimes keep for a year or more.

Such preparations show that the medullary sheath is a structure of more importance than has generally been supposed by physiologists and pathologists. The differences brought out by this process of double-staining appear to indicate a difference in function among the nerve-fibres. The division into *motor* and *sensory* fibres, as Sahli suggests, may not go to the root of the matter. The central nervous system may be built up on a much more complicated principle of division.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Kent Scientific Institute of Grand Rapids, Mich.—The following officers were elected to serve for the year 1888: President, E. S. Holmes; Vice-President, W. A. Greeson; Recorder, C. A. Whittemore; Corresponding Secretary, E. S. Holmes; Treas-

then washed a few minutes in water (until visible streams of the solution cease to issue from the preparation), before immersion in the staining fluid. The staining may be successful with celloidin sections, provided they are very thin. It is better, however, to remove the celloidin, and subject the sections again to the hardening fluid, preparatory to staining.

urer, Samuel L. Fuller; Director of Museum, W. A. Greeson; Curator of Museum, C. W. Carman; Librarian, Geo. E. Fitch. Board of Directors: for one year, Joel C. Parker; for two years, Wright L. Coffinberry; for three years, W. A. Greeson; for four years, Samuel L. Fuller; for five years, E. S. Holmes; for six years, J. W. Jones.

Biological Society of Washington.—At the meeting held October 20th, 1888, the following communications were read: Mr. L. O. Howard, "An Apparatus for the Study of Underground Insects and Plant-Roots;" Prof. Lester F. Ward, "The King Devil;" Mr. J. B. Smith, "Some Remarks on Sexual Characters in Lachnosternum;" Dr. Theo. Gill, "The Families of Fishes."

November 3, 1888.—The following communications were read: Mr. F. H. Knowlton, "Fossil Wood and Lignites of the Potomac Formation;" Mr. W. H. Dall, "Observations on the Modifications of the Gill in Univalve Molluscs;" Dr. Theo. Gill, "Characteristics of the *Scatophagidæ;*" Dr. C. Hart Merriam, "Description of a New Species of *Arvicola* from the Black Hills of Dakota."

November 17, 1888.—Prof. Lester F. Ward, "A Comprehensive Type of Fossil Cryptogamic Life from the Fort Union group, with Lantern views;" Mr. F. H. Knowlton, "Illustrations of Fossil Wood and Lignites of the Potomac Formation with Lantern views;" Dr. Cooper Curtis, "Some sexual differences in Trichocephali;" Prof. B. F. Fernow, "Geotropism and Heliotropism of Trees;" Dr. Theo. Gill, "On the relations of the Pscychrolutidæ;" Dr. C. Hart Merriam, "Description of a new Ground Squirrel from California."

U. S. National Academy of Sciences.—Papers read November, 1888, in New Haven.—I. "The Lunar Eclipse, July 22, 1888,"[1] by E. S. Holden. II. "The Zone Undertaking of the Astronomische Gesellschaft," by Lewis Boss; presented by A Hall. III. "The Rain-Fall of the North Atlantic Ocean,"[2] by Elias Loomis. IV. "A finished Breed of Horses,"[1] by W. H. Brewer. V. "A Systematic Study of the Action of Definitely Related Chemical Compounds upon Animals,"[1] by Wolcott Gibbs and Hobart Emory Hare. VI. "The Cretaceous Flora of North America," by J. S. Newberry. VII. "On the Zoological Relations of some Palæozoic Fishes," by J. S. Newberry. VIII. "The Evolution of the Mammalian Molar Teeth to and from the Tritubercular Type,"[2] by Henry F. Osborn; presented by E. D. Cope. IX. "Some Scientific Results of the Albatross Expedition from Washington to San Francisco,"[2] by L. A. Lee; presented

[1] Read November 13th.
[2] Read November 14th. The remainder read November 15th.

by A. E. Verrill. X. "Some Measurements of Relative Wave-lengths," by A. A. Michelson and E. W. Morley. XI. "A New Mineral from Maine," by E. S. Dana. XII. "Remarks on the Expression of the Law of Attraction in the Stellar Systems," by C. H. F. Peters. XIII. "Notes on the Satellite of Neptune," by A. Hall. XIV. "The Problem of Soaring Birds," by G. K. Gilbert. XV. "The Laws of Corrasion," by J. W. Powell.

THE WESTERN SOCIETY OF NATURALISTS held its first annual meeting October 24th and 25th, 1888, in the Physical Lecture-room of the Illinois State University, Champaign, Ill. Twenty-six members, representing six States, were in attendance. The meeting was called to order by the President, Dr. S. A. Forbes, and welcomed to the State and to Champaign by Prof. T. J. Burrill, Vice-President of the University. The first paper, on the "Teaching of Botany," was by Dr. D. H. Campbell, of Indiana University. He advocated the logical method of beginning with the simple and leading up to the complex, even with pupils as young as those in the high-schools, and the constant use of the compound microscope. The discussion which followed showed considerable diversity of opinion as to method, but all were agreed in relegating the analysis of flowers to the background. The other paper of the afternoon was by Prof. W. J. Beal, of the Michigan Agricultural College, who gave an account of a museum of plant products.

In the evening, Dr. S. A. Forbes, of the Illinois State University, gave the presidential address, detailing the character, scope, and objects of the Society, and then Pres. T. C. Chamberlain, of the Wisconsin State University, detailed the methods of investigation in quaternary geology.

Thursday morning the following papers were read: "Collegiate Instruction in Physiology," by Prof. O. P. Jenkins, of DePauw University; "Collegiate Instruction in Geology," by Prof. Samuel Calvin, of Iowa University; and "Biology in the High School," by Prof. W. H. Hatch, of Rock Island. Prof. J. T. Burrill exhibited a convenient and compact apparatus for taking photographs of microscopic objects, and explained its use. Prof. O. P. Jenkins exhibited a simple microtome invented by Prof. J. P. Naylor, which would cut ribbons of sections, the thinness of which is only limited by the pitch of the screw and the edge of the razor, while the instrument could be manufactured at a profit for ten or fifteen dollars. The following officers were elected for the ensuing year: President, Dr. T. C. Chamberlain, of Madison, Wis.; Vice-Presidents, Prof. J. T. Burrill, of Champaign, Ill., Pres. D. S. Jordan, of Bloomington, Ind., Prof. Samuel Calvin, of Iowa City, Iowa; Secretary, Prof. J. S. Kingsley, of Bloomington, Ind.; Treasurer, Prof. John M. Coulter, of Crawfordsville, Ind. It was

voted to hold the next annual meeting in Madison, Wis., in October, 1889, the exact date to be set by the Executive Committee.

Friday afternoon, after the transaction of some business, Dr. S. A. Forbes and Prof. H. Garman presented an account of the methods of investigating the contagious diseases of insects. Dr. C. O. Whitman, after giving several hints in matters of microscopical and embryological technique, outlined his plans for an inland biological laboratory, for which he asked the co-operation and active support of the colleges and universities of the Northwest. Prof. W. A. Locy, of Lake Forest University, read a paper on the "Teaching of Zoology in Colleges." Prof. Josua Lindahl exhibited a simple instrument he had devised for obtaining the contours and outline sections of skulls and other objects. After passing the usual resolutions and also one expressing their interest and intention to aid in the establishment of the laboratory advocated by Dr. Whitman, the Society adjourned.

American Association for the Advancement of Science. —*Report of the committee to secure from Congress the abolition of the duties on scientific books and apparatus imported into this country.* —The committee made the following report:—

Shortly after its appointment Dr. J. S. Billings resigned, suggesting that a member from the West be selected to fill his place. Prof. Langley, president of the Association, therefore appointed Prof. A. H. Worthen, of Springfield, Ill., to the vacancy. Upon the death of Prof. Worthen, which followed not long after, Prof. S. A. Forbes of Champaign, Ill., was selected by Prof. Langley to fill his place.

The eastern members of the committee, Paof. J. R. Eastman and Prof. E. D. Cope, chairman, have held several meetings with the following results. The following resolution was adopted and signed by all the members:—

Resolved: That there shall be admitted to this country, free of duty, all books in languages other than English; of books in the English language all single copies sent to periodicals issued not oftener than once a week; all books issued by governments and scientific societies, and all other books not republished within a year after the first publication in an English-speaking country.

Also all apparatus, instruments and material to be used in scientific experiment or original research; decision as to the intention of the importer to rest with a committee of the U. S. National Academy of Sciences.

This resolution was placed in the hands of the Committee of Ways and Means of the House of Representatives of which the Hon. R. Q. Mills is chairman, through Hon. W. C. P. Breckinridge of Kentucky, one of its members. The resolutions were received with consideration and had the attention of the committee while engaged in framing what is known as the Mills Tariff Bill. The

recommendations contained in the resolutions were partially incorporated into the bill in the following language (H. R. 9051, p. 1 and 7).

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, that on and after the first day of July, 1888, the following articles mentioned in this section, when imported, shall be exempt from duty:

"Bibles, books and pamphlets printed in other languages than English, and books and pamphlets and all publications of Foreign Governments, and publications of Foreign Societies, historical or scientific, printed for gratuitous distribution."

This provision, although not covering the case of scientific publications produced in England, is a great advance over previous legislation on the subject.

As it is probable that the Mills bill in its present shape will not pass the Senate, and as the Senate is preparing a tariff bill as a substitute for it, the resolutions of your committee have been submitted to the committee of the Senate engaged in preparing this bill, of which Senator W. B. Allison is chairman. There is every reason to believe that the suggestions therein contained will receive the respectful consideration of that committee.

It has been hoped that some relief from the tax on knowledge at present imposed by the government of the United States might be largely relieved by the operation of the bill which has passed both houses of Congress, known as the Chace copyright bill. Such relief would really result, in the case of scientific books of which the sale should be sufficiently large to justify their republication in this country by foreign publishers, since they would then cease to be imported; but, unfortunately, the books most needed by students engaged in original research in this country are generally of a kind that are not republished, owing to the limited demand for them relatively to other kinds of literature.

By resolution of the American Society of Naturalists, your committee has been made the recipient of the following preambles and resolutions, and its request for the presentation of the same to Congress:—

"Whereas, the cause of education in science is retarded by the restrictions placed by Congress on the importation of scientific books and apparatus: whereas we believe that advance in the arts and industries depends on the development of science and is impeded by the before-mentioned import duties, and that all restrictions on education and scientific research are unworthy of enlightened government: whereas the scientific books published abroad are absolutely essential to students and investigators, and are but rarely duplicated in this country: whereas the value of scientific apparatus is in nearly all cases dependent on the individuality of the maker: and whereas colleges and incorporated institutions are now permitted to import apparatus duty free, while private investigators, usually less able to afford expense, are obliged to pay duty, therefore

"*Be it resolved*, That ——— hereby requests the Representatives of the state of ——— in the Congress of the United States to use all pos-

sible efforts to have placed on the free list, books pertaining to the physical, natural and medical sciences, and apparatus intended for purposes of scientific research or of education: and further be it

"*Resolved*, That a copy of these preambles and resolutions be forwarded to each member of Congress."

These resolutions were sent, by resolution of the same society, to the faculties of the universities and colleges throughout the United States for their approval and signature. Replies expressing this approval and signed by the faculties, or their accredited officers, were received from the following institutions:—

The American Philosophical Society, Philadelphia; The Franklin Institute, Philadelphia; the Academy of Natural Sciences, Philadelphia; the County Medical Society, Philadelphia; the Society of Arts, Boston; Brown University, Providence, R. I.; Bryn Mawr College, Pa.; Wellesley College, Mass.; Iowa College, Iowa; Michigan University, Ann Arbor, Mich.; Wesleyan University, Middletown, Conn.; Naval Academy, Annapolis, Md.; Middlebury College, Vt.; Hamilton College, Clinton, N. Y.; Swarthmore College, Pa.; Adelbert College, Ohio; Williams College, Williamstown, Mass.; College of the City of New York; University of Alabama, Tuscaloosa, Ala.; Lafayette College, Easton, Pa.; Amherst Agricultural College, Amherst, Mass.; Haverford College, Pa.; Smith College, Mass.; Columbian University, Washington, D. C.; Stevens Institute of Technology, Hoboken, N. J.; University of Indiana, Indiana; Lehigh University, Bethlehem, Pa.; University of California, Berkeley, Cal.; Hobart College, New York; College of Physicians and Surgeons, New York City; University of North Carolina, N. C.; Columbia College School of Mines, New York City; Union College, New York; Kenyon College, Ohio; Northwestern University, Evanston, Ill.; Marietta College, Ohio; University of Virginia, Charlottesville, Va.; Cornell University, Ithaca, N. Y.; Hampden Sidney College, Va.

As regards the removal of duty from imported philosophical and scientific apparatus, your committee cannot report much progress. Our efforts have been mainly directed to the removal of the duty on books, under the belief that success in this direction will prepare the way for further advance. We have not, however, neglected this important subject. The Mills tariff bill thus refers to it (pp. 27 and 32):

(p. 32.) "And on and after October first, 1888, in lieu of the duties heretofore imposed on the articles hereinafter mentioned in this section, there shall be levied, collected and paid the following rates of duty on said articles severally."

"Philosophical apparatus and instruments, twenty-five per centum ad valorem.

Your committee hope to be able to secure the total abolition of the duties on foreign books of science, and the great reduction, if not abolition, of those on apparatus. We base this hope on the activity in the direction of change in the existing laws on this subject, at present existing in Congress, and the evident desire of the representatives of both the great political parties of the country to legislate for the best interests of their constituents, as they understand them. At the moment of preparing this report it is not

possible to announce any final result of the action of your committee, but it is quite possible that improved legislation may be attained by the time of the meeting of the Association to which this report is made.

In conclusion we find that what is needed to effect the result desired, is a continuation of the effort, already commenced, of vigorous protest against the laws on the subject as at present existing; laws which obstruct knowledge at its fountain-head; which impose onerous burdens on a class which works gratuitously for the public good, and which place our country in a false position among the enlightened nations of the earth.

EDW. D. COPE, Philadelphia, *Chairman.*
J. R. EASTMAN, U. S. Naval Observatory, Washington, D. C.
S. A. FORBES, Champaign, Ill.

SCIENTIFIC NEWS.

—Dr. Paul Langerhans, formerly professor in Freiburg i. B., died in Funchal, Madeira, July 20th, 1888, aged forty-one years.

—A heavy earthquake shock was felt in the city of Mexico, September 6th, 1888. In its violence it exceeded any hitherto recorded there.

—Prof. Graf zu Solms-Laubach, of Tübingen, succeeds to Prof. de Bary's place as editor of the *Botanische Zeitung*, while Dr. Kohl, of Marburg, has accepted the position of editor of the *Botanische Centralblatt.*

—The Indiana Academy of Science will hold its fourth annual meeting at Indianapolis, December 25th to 27th. The address of the retiring President, Dr. J. P. D. John, will be given on the evening of the 25th. As last year the programme was crowded, it has been decided to organize four sections this year: A, Zoology; B, Botany; C, Chemistry, Physics, and Mathematics; D, Geology and Geography.

—The British Association at its Bath meeting made the following grants for Geology, Biology, Geography and Anthropology: Geological Record, £80; Erratic Blocks, £10; Volcanic Phenomena of Japan, £25; Volcanic Phenomena of Vesuvius, £20; Fossil Phyllopoda of the Palæozoic Rocks, £20; Eocene Beds of the Isle of Wight, £15; Fossil Secondary and Tertiary Plants of the United Kingdom, £15; Zoology and Botany of the West

Indies, £100; Marine Biological Association, £200; Flora of China, £25; Physiology of the Lymphatic System, £25; Deep-sea Tow-net, £10; Natural History of the Friendly Islands, £100; Geography and Geology of the Atlas Range £100; Effect of Occupation on Physical Development, £20; Northwestern Tribes of Canada, £150; New Edition of Anthropological Notes and Queries, £50; Calculating the Anthropological Measurements taken at Bath, £5; Exploration of Roman Baths at Bath, £100; Characteristics of Nomad Tribes of Asia Minor, £30. Apparently no grant was made this year for the Zoological Record, a work which may well be allowed to lapse, since its place is so much better filled by the Naples "Jahresbericht."

—REWARDS FOR MERITORIOUS DISCOVERIES AND INVENTIONS. —The Committee on Science and the Arts of the Franklin Institute, of the State of Pennsylvania, is empowered to award, or to recommend the award of, certain medals for meritorious discoveries and inventions, which tend to the progress of the arts and manufactures.

These medals are:—

1.—*The Elliott Cresson Medal* (*gold*), to be awarded either for some discovery in the arts and sciences, or for the invention or improvement of some useful machine, or for some new process, or combination of materials in manufactures, or for ingenuity, skill, or perfection in workmanship.

2.—*The John Scott Legacy Premium and Medal* (*twenty dollars and a medal of copper*) was founded in 1816, by John Scott, a merchant of Edinburgh, Scotland, who bequeathed to the City of Philadelphia a considerable sum of money, the interest of which should be devoted to rewarding ingenious men and women who make useful inventions. The premium is not to exceed twenty dollars, and the medal is to be of copper, and inscribed "*To the most deserving.*"

—The following is taken from the New York *Herald:* The Peabody Museum of American Archæology and Ethnology, of Cambridge, Mass., through the liberality of Mr. Charles P. Bowditch, of Boston, and other gentlemen interested in the subject, is about to send an expedition to explore the ruins of Yucatan, the command of which has been offered to Consul Edward H. Thompson, who has accepted. As a practical archæologist and writer upon the subjects connected therewith, Mr. Thompson is already eminent. His large experience and valuable discoveries among the lost cities in the almost unknown interior of Yucatan and Central America, make his selection for the proposed work most promising for its success. His present position as Consul to Yucatan was proffered him by our government with a view to a thorough ethnological and archæological study of the ruins in that country. The expedition will occupy several months. The draughtsman, photographer and naturalist will probably leave the United States in December.

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SURFACE GEOLOGY OF BURLINGTON, IOWA.

BY CHARLES R. KEYES.

THE sedimentary rocks of Burlington have afforded such unrivaled facilities for the study of an extensive piscine and crinoidal fauna that attention has been almost totally diverted not only from other well represented faunal groups, but also the equally interesting stratigraphical and cenological features of that vicinity. While the palæontological researches were being so assiduously carried on, regional stratigraphy necessarily received, at divers times, more or less consideration, and is comparatively well understood. Recently a detailed investigation of the superficial deposits of the region was instituted, and a preliminary notice of the observations over a limited area is herewith presented.

The general geographical features of the annexed map have been compiled from Powers' map of the city of Burlington and a portion of the map of Des Moines county, as given in Andreas' Historical Atlas of Iowa. In a few minor particulars, observation has necessitated some corrections and additions. The hypsometrical features are approximately accurate—the contours (twenty feet apart) having been, for the most part, constructed from measured street and railway elevations, and, especially in the northern third of the area represented, from measurements personally made with level and rod. Over certain areas of limited extent estimates from points of prominence were also made. Along the eastern margins of North and Prospect hills the contours should in reality form a single line, but it has been deemed more advisable, for reasons hereafter stated,

to deviate slightly from actuality, and project the individual contours distinctly.

The drift over the region cartographically represented in Plate XXIII, exhibits only the "Lower Till"—the southern boundary of the "Upper Till," or the till of the second glacial epoch, being considerably to the northwestward. Over this portion of the state the drift is usually more or less modified superficially. The boulders contained are for the most part comparatively few and of small size; they are seldom more than five or six feet in diameter, though a few miles from Burlington one is to be seen, the diametric measurement of which is more than fifteen feet. The preglacial surface expression of the region under consideration has manifestly not been completely obliterated by glaciation and the concomitant depositions, and the present topographic features are consequently in greater or less degree dependent upon the subjacent stratigraphic rocks which make up the greater portion of the altitude of the bluffs on either side of the Mississippi river at this point. The extreme attenuation of the till over the more elevated areas, and the deep accumulations of drift materials over the less elevated places, is evidenced by numerous exposures. In the valleys of Flint, Hawkeye and other smaller creeks, the depositions of the till attain a maximum thickness in some places of seventy or eighty feet.

The city of Burlington is built upon four "hills," all of which rise to a height of nearly two hundred feet above low water[1] in the Mississippi river at that place. Perhaps five-sixths of the altitude is formed of Burlington limestone and Kinderhook shales, which along the Mississippi river at Prospect and North hills, and also some parts bordering Flint creek, rise from the water's edge in high mural escarpments.

North of Hawkeye creek is a nearly insulated plateau, all sides of which are scalloped by steep-sided ravines, very deep toward the lower extremities, but interiorly becoming quickly lessened in depth,

[1] This is the basis of all elevations given in the accompanying map, and is assumed to be 510.77 feet above the sea-level. It was determined from a line of precise levels recently run by the Mississippi River Commission up the Mississippi river from the Gulf of Mexico, which gives the elevation of the U. S. P. B. M. 14, on the north end of the east abutment of the C. B. and Q. R. R. bridge over the Mississippi river at Burlington as 171.4352 meters.

and the larger ones soon passing into small, broad, shallow drainage basins, which impart to the central portion of the plateau a characteristic, gently undulatory appearance. To the northeastward is a small subsidiary plain of subdued undulatory topography, evidently in no way dependent upon the underlying stratigraphic rocks. It rises thirty or more feet above the broad alluvial flood plain of the Mississippi river, and is divided by the Flint creek. Southwestward it passes rather abruptly into the comparatively gentle slopes of the general plateau. It manifestly occupies the preglacially corroded valley of Flint creek, and laterally rests upon the irregularly eroded slopes of the ancient water course. A section of this limited auxilliary plain exhibits the following structure: the exposure is continuous for nearly half a mile on Flint creek, and is practically similar throughout.

SECTION I.[1]

1. Course, brown, friable loam, with occasional small pebbles, gradating imperceptibly into No. 2.............................. 3 feet.
2. Yellowish-brown clay of a characteristic fissured nature; containing a few small boulders or large pebbles, in places indistinctly laminated.. 15 feet.
3. Commingled sand and gravel irregularly stratified; pebbles up to six inches in diameter, mostly rounded, erratic, but with numerous local angular flint and limestone pieces............ 10 feet.
4. Drab, homogeneous unctuous clay........................ 2 feet.
5. Coarse yellow and white sand, with a few small, erratic pebbles, everywhere quaquaversally stratified..................... 6 feet.
6. Very fine homogeneous white sand (this is not present along the entire section)... 1 foot.
7. Coarse yellow and white sand, with rounded and striated erratic pebbles up to two feet in diameter, and larger local angular fragments of flint and fossiliferous (Burlington) limestone, exposed... 12 feet.

One mile above on Flint creek the coarse yellow sands form a conspicuous feature. A short distance further north the lower till,

[1] The several sections selected are regarded as the most typical of the numerous exposures examined, and are marked on the accompanying map.

with numerous small, rounded erratic boulders up to four feet in diameter, is well exposed in all its characteristic details. It is overlaid by six to eight feet of typical loess, containing numerous small lœsskindchen. The deposits here presented have an exposed thickness of sixty feet, and are seen to lean against the steep sides, the rather narrow gorge preglacially eroded by the waters of Flint creek to a depth of more than one hundred and thirty feet. North of Flint creek, and beyond the area represented in the annexed map, the topography in its general aspect is similar to that of the insulated plateau south. On the upper brow of the north slope of "North hill," a road cutting discloses the following arrangement:—

SECTION II.

1. Brownish-yellow clay, free from gravel, and for the most part homogeneous; gradating into No. 2............................ 5 feet.

2. Typical ashen compact loess 'aining numerous small loesskindchen and the following fossils:—

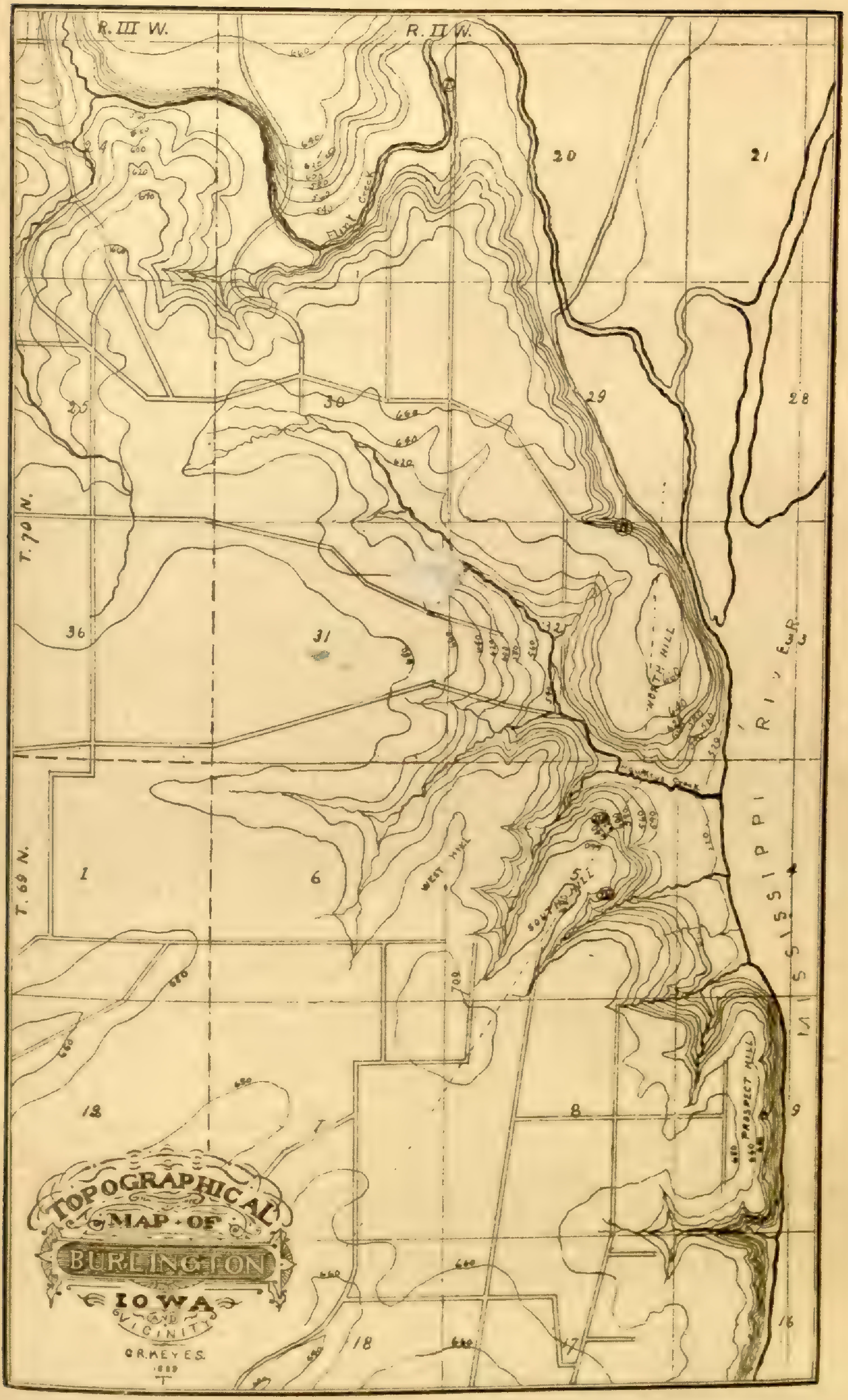
Pupa muscorum Linn.	*Succinea obliqua* Say.
Patula striatella Anth.	*Limnophysa desidiosa* Say.
Patula perspectiva Say.	*Helicina occulta* Say.......8 feet.

3. Till with an abundance of gravel, and pebbles up to three feet in diameter, exposed................................. .... 20 feet.

Over the entire central portions of the northern plateau the distribution of quaternary deposits is essentially the same, except the lower member suffers a considerable attenuation over the more elevated parts, sometimes being reduced to a few feet in thickness. Upon removal of the drift materials glacial scorings and striæ on the subjacent palæozoic stratum have been disclosed in various places.

South of the Hawkeye creek rises a broad elevated plain so level in many places as to be almost devoid of natural drainage. Northeastward it is scalloped by short, deep ravines, but eastward it abruptly terminates with a perpendicular declivity, washed at its base by the Mississippi river, which has evidently separated the plateau from the highland of Henderson county, Illinois. To the southward and westward this level elevated plain gradually becomes gently undulatory and finally more broken by the small tributaries of Spring creek. Northwestward it merges into the general elevated

PLATE XXIII.


TOPOGRAPHICAL
MAP OF
BURLINGTON
IOWA
AND
VICINITY
C.R. KEYES.
R. III W.
R. II W.
T. 70 N.
T. 69 N.
Flint Creek
NORTH HILL
WEST HILL
SOUTH HILL
PROSPECT HILL
MISSISSIPPI RIVER
20
21
29
28
30
25
36
31
32
1
6
12
8
9
18
17
16

plain occupying the greater portion of the county. Near the summit of "South Hill" section III. is exposed in a recently opened quarry :—

SECTION III.

1. Brownish clay, free from pebbles, becoming silty below, and gradating insensibly into No. 2.. 5 feet.
2. Compact ashen loess containing lösskindchen............. 9 feet.
3. Red tenacious clay, upper portion containing much gravel, the pebbles small, rounded, mainly erratic, a few local flint and limestone fragments disseminated throughout....................... 1 foot.
4. Large angular fragments of limestone and flint, the interstices filled with red clay... 2 feet.
5. Upper Burlington limestone, exposed.................. 20 feet.

One quarter of a mile to the southeast, on the corner of south Fourth and Maple streets, a similar arrangement is shown, superimposing the *lower* Burlington limestone. The quaternary beds of the two places are manifestly continuous, but the elevation of the latter section is somewhat less than the former, and the deposits are all intensified; No. 1 of section III. having a thickness of six feet, No. 2 of 13 feet, and Nos. 3 and 4 together, of 6 feet. Southwestward from this exposure, perhaps one-fourth of a mile, a road cutting exhibits :—

1. Brownish-clay silty or loess-like below.................. 10 feet.
2. Typical lower till.. 25 feet.
3. Lower Burlington limestone, exposed................. 5 feet.

Summarizing the observations herein briefly recorded, it is to be noted: (1) That the loess at Burlington, as in other portions of Iowa, occurs only over the elevated areas, and the fossils contained are all depauperate, evidencing, as pointed out by McGee and Call,[1] a much lower temperature of the air than at the present time, for it is also urged by those writers that the deposits of loess took place in ice-bound basins; (2) that the loess over the region under consideration has been by atmospheric agencies more or less modified superficially, often to a depth of five or six feet—the upper portion losing entirely its original character, but downward passing by insensible gradations into typical loess. This modification of the

[1] Am. Jour. Sci., Vol. XXIV., Sept., 1882.

superior portion of the löss mantle is in many respects very similar to analogous changes superficially in the aspect of the residuary clays over certain parts of the driftless area lying in the northeastern portion of the state, and the contiguous parts of Illinois and Wisconsin —more specifically referred to by Chamberlain and Salisbury;[1] (3) that the stratigraphic rocks bordering the Mississippi river suffered considerable abrasion during the sojourn of the glacier, as is attested by numerous larger fragments of flint and limestone, which are manifestly not far removed from their origin, and also by the observed surfaces of striation over the elevated portions of the area cartographically represented by fig. 1; and (4) that the till which on the retreat of the glacier nearly, if not entirely, filled preglacially corraded channels has since been more or less completely removed from the numerous deep ravines occurring on all sides of the elevated plateaus of the region.

ON THE INFLUENCE OF CIRCUMSTANCES ON THE ACTIONS AND HABITS OF ANIMALS, AND THAT OF THE ACTIONS AND HABITS OF LIVING BODIES, AS CAUSES WHICH MODIFY THEIR ORGANIZATION.

BY J. B. P. A. LAMARCK.[2]

(Continued from page 972.)

THAT which proves it, is that this is not true of the organ of hearing, which is always found in animals where the nature of their organization requires it. This is the reason. The material of sound, that which is moved by the shock or vibrations of bodies, transmits to the organ of hearing the impression which it has received from them, and penetrates everywhere, traversing all media, and even the masses of the most solid

[1] U. S. Geol. Sur., Sixth Ann. Rep.

[2] Translated by Dr. E. E. Galt, from the edition of 1809.

bodies; any animal which possesses a plan of organization in which hearing is essential, has always occasion to exercise this organ in whatever place it inhabits. Therefore, among vertebrate animals, one sees none which are deprived of the organ of hearing; but below them, when the same organ is wanting, we do not find this sense in any of the animals of succeeding classes. It is not thus with the organ of sight, for one sees that organ disappear, reappear, and disappear again, by reason of the possibility or the impossibility of the animals exercising it. In the *Mollusques acephales,* the great development of the mantle has rendered their eyes and their head altogether useless. These organs, although taking part in a wider plan of organization which comprehends them, have necessarily disappeared and become obliterated by constant disuse. Finally it enters into the plan of organization of reptiles, as of other vertebrate animals, that they should have four feet belonging to their skeletons. Serpents should have, consequently, also four feet, the more so as they do not constitute the last order of reptiles, and since they are less related to fishes than are batrachians (frogs, salamanders, etc.). Now, snakes having adopted the habit of crawling on the ground, and of hiding themselves under bushes, their bodies, in consequence of long-repeated efforts to elongate themselves, in order to pass into narrow places, have acquired a considerable length, and in no wise proportionate to their thickness. Now, feet would have been very useless to these animals, and without employment. Long feet would have been a hindrance to creeping, and very short feet, even to the number of four, would have been incapable of moving their bodies. Thus, the disuse of these parts having become constant in the races of these animals, has caused these same parts to disappear entirely, although they were really in the plan of organization of animals of their class. Many insects, which from the natural character of their order, and also of their genus, should have wings, lack them more or less completely, from disuse. Numbers of Coleoptera, Orthoptera, Hymenoptera, and Hemiptera, etc., present examples, their habits never permitting them to make use of their wings. But it is not enough to give the explanation of the cause which has brought about the condition of organs of different animals, conditions which one sees always the same in those of like species. It is necessary besides to show these

changes of conditions acting in the organs of some one individual during its life as the sole result of a great change in the habits peculiar to the individuals of its species. The following remarkable fact fully proves the influence of habits on the condition of organs, and how continued changes in the habits of an individual bring changes in the state of the organs which enter into action during the exercise of these habits. M. Tenon, member of the Institute, has communicated to the *Classe des Sciences*, that having examined the intestinal canal of many men who have been ardent drinkers during a great part of their life, has constantly found it shortened to an extraordinary degree compared with the same organ of all those who had not a like habit. It is known that great drinkers or those who are given to drunkenness, take very little solid food; that they eat almost nothing, and that the drink which they take in abundance and frequently, suffices for their nourishment. Since fluid aliment, and, above all, spiritous drinks, do not remain long either in the stomach or in the intestines, the stomach and the rest of the intestinal canal loses in drunkards the habit of distention. So also in persons of sedentary habits, and constantly applied to mental work, who habituate themselves to take very little nourishment. Gradually, in time, their stomachs contract, and their intestines become shortened. It is not a question here of shrinking and shortening produced by a contraction of parts which would permit of ordinary extension, if in place of a maintained vacancy these viscera should become filled; but it is a question of real shrinking and considerable shortening, so that these organs would rather burst than yield suddenly to the causes which would produce ordinary distension. Circumstances of age being entirely equal, compare a man who habitually devotes himself to studies and mental work, who has rendered his digestion sluggish, has contracted the habit of eating very little, with another who habitually and often takes much exercise and eats well; the stomach of the first would have reduced functions, and a very small quantity of aliment would fill it, whilst that of the second would be preserved and even increased. See then an organ greatly modified in its dimensions and functions by the one cause of a change in its habits during the life of the individual. The frequent employment of an organ in becoming adapted to its habits, augments the function

PLATE XXIV.

FIG. 1.

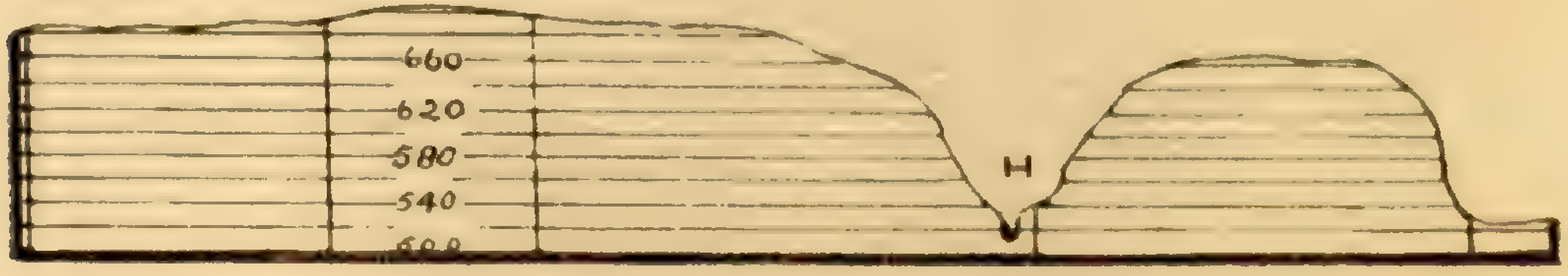


FIG. 2.

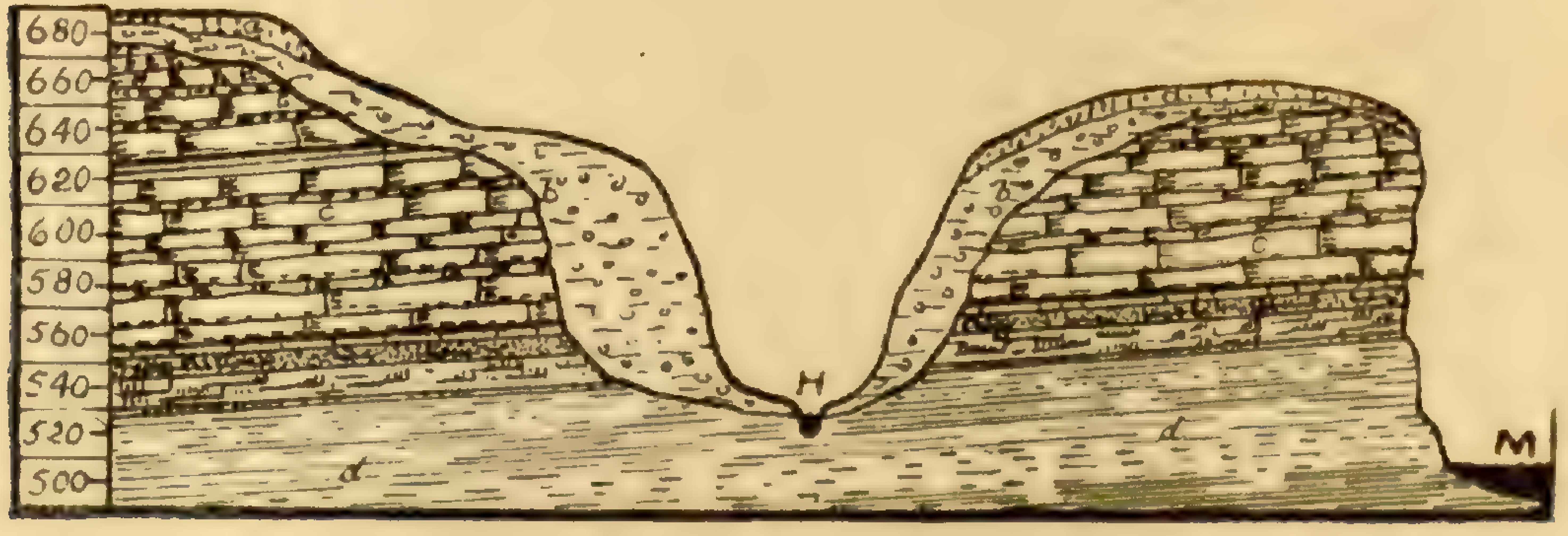


FIG. 3.
Sections at Burlington, Iowa.

of that organ, develops it, and makes it acquire dimensions and force of action which it has not in animals which exercise it less. One comes to see that the disuse of an organ which has existed, modifies, impoverishes, and finally obliterates it. I will now demonstrate that the continual employment of an organ, with the efforts made in keeping its place in the circumstances under which it exists, strengthens, extends, and increases that organ, or creates new ones which are able to exercise the functions which have become necessary.

The bird that hunger (necessity) attracts to water to find there the prey on which it lives, separates its toes and its feet when it strikes the water, and moves on its surface. The skin which unites these toes at their base, acquire the habit of extending themselves by these perpetual spreadings; thus, after a time, the large membranes are formed which we see uniting the toes of ducks, geese, etc. The same efforts made to swim, that is to say, to push the water in order to advance and move in that liquid, have developed the same membrane which is between the toes of frogs, sea-turtles, the otter, the beaver, etc. On the contrary, the bird that its manner of life habituates to roost in trees, and who proceeds from individuals who have all contracted that habit, has necessarily the toes more elongated and shaped otherwise than those of aquatic animals which I have cited. Their nails, after a time, become long, sharp, and curved in a hook by holding so often the limbs on which the animal rests. So it is known of river birds who do not swim, and who only desire to approach the borders of the water to find their prey, are continually exposed to being forced into the mud. Now this bird, wishing to act so that its body may not be wet, makes great efforts to extend and elongate its feet. It follows from the continued habits which this bird, and all those of its race have contracted in continually extending and elongating its legs, that the individuals of this race are found elevated on stilts, and have also gradually obtained long boots. That is to say, they are denuded of feathers as far as the thighs and often beyond (*Systeme des Animaux sans Vertebres*, p. 14). It is known also that the same bird, wishing to pick without wetting its body, is obliged to make continuous efforts to elongate its neck. Now, to the continuance of these habitual efforts in this individual, and those of its race, they owe that, after

a time, they acquire the singular elongation of the neck, as is seen in river birds.

If some swimming birds, as the swan and the goose, and of which the feet are short, have, nevertheless, a very long neck, it is because in walking in the water they have the habit of plunging their heads below as deeply as they are able, to take the aquatic larvæ and different animalcules which nourish them, and that they have no reason for stretching their feet. If an animal, for the satisfaction of its wants, should make repeated efforts to elongate its tongue, it would acquire considerable length (*e.g.*, the ant-eater, the "pic-verd"). If it wants to seize something with the same member, then its tongue will divide and become forked. That of humming-birds, who seize with their tongue, and of lizards and snakes, who use theirs to feel and investigate bodies which are before them, are the proofs of that which I advance. Wants, always occasioned by circumstances, and followed by continued efforts to satisfy them, are not limited in their results to modify, that is to say, to augument or diminish, the extent or the functions of these organs, but they succeed in displacing these same organs where certain of these wants make it a necessity.

Fishes which swim habitually in large bodies of water, having occasion to see laterally, have their eyes placed on the sides of the head. Their body, more or less flattened according to the species, has its edges perpendicular to the plane of the water, and their eyes are placed in such a manner that they have an eye on each flattened side. But those fishes whose habits involve the necessity of constantly approaching rivers, particularly rivers little inclined or with gentle descent, have been forced to swim with one side downwards in order to be able to approach near the edges of the water In this situation, receiving more light from above than below, and having particular reason for always being attentive to that which they find above the water, this want has forced one of their eyes to undergo a kind of displacement, and to take the very singular situation which is known in soles, turbots, "limandes," etc. (the Pleuronectes and the "Achires"). The situation of these eyes is not symmetrical, because there has resulted an incomplete mutation. Now this mutation is entirely finished in the rays, where the transverse flattening of the body is altogether horizontal; so with the

head. Thus the eyes of rays, both placed on the superior face, are rendered symmetrical.

Snakes which crawl on the surface of the earth, having reason principally to see elevated objects, or those which are above them, this necessity has influence on the situation of the organ of sight in these animals, and, in fact, it has placed the eyes in the lateral and superior part of the head, in position to perceive easily that which is above them or at their sides, but they cannot see that which is above them or but little distance in front. Now, forced to make up for the lack of sight in recognizing objects which are before them, and which might hurt them in advancing, they have been able to feel these objects only by aid of their tongue, which has obliged them to stretch it out with all their might. This habit has not only contributed to render this tongue thin, very long, and very contractile, but further, has forced it to divide itself, in a great number of species, to feel several objects at a time; it has formed an opening at the extremity of their muzzle, to pass without being obliged to open the jaws.

Nothing is more remarkable than the production of habits in herbivorous mammals. The quadrupeds to which circumstances and the wants which they have brought about, have given the habit of browsing on herbs, walk only on the earth, and find themselves obliged to rest on their four feet the great part of their life, executing generally few of the ordinary movements of other Mammalia. The considerable time which this kind of animal is forced to employ every day, to replenish itself with the only kind of food which it uses, requires that it make little movement, that it employ only its eet to sustain itself on the ground, to walk or run, and that it never exerts itself to hang to or to grasp the trees. From this habit of consuming all day, great quantities of alimentative materials which distend the organs which receive it, and of making only ordinary movements, it has resulted that the bodies of these animals are considerably thickened, become heavy and massive, and have acquired a very great volume, as one sees in the elephant, rhinoceros, cattle, buffalo, deer, etc.

The habit of resting upright on their four feet during the greater part of the day to browse, has caused a thick hoof to grow, which envelope their toes; and as these toes are resting without exercising any move-

ment, and are serving no other purpose than to sustain them as well as the rest of the foot, the greater part of them are shortened, are obliterated, and so finally disappear. Thus, in the pachyderms, some have five toes on the feet enveloped in horn, and in consequence their hoof is divided into five parts; others have only four, and others still only three. But in the ruminants, the most ancient of mammals, which are confined to sustaining themselves on the ground, there are only two toes to the feet. It is also found that there is but one toe in solipedes (the horse, the ass). Now, among these herbivorous animals, and particularly among the ruminants, it is found that, from the circumstances of the wild country which they inhabit, they are constantly exposed to become the prey of carnivorous animals, and to be able to find safety only in precipitate flight. Necessity has then forced them to exercise themselves in rapid running; and from the habit which they have acquired, their bodies have become more slight, and their limbs slenderer: one sees examples in the antelope, gazelles, etc. The deer, roe-buck, fallow-deer, etc., are exposed to perish by the chase, or pursuit by man. This risk has reduced them to the same necessity, has constrained them to the same habits, and has produced the same results in them. The ruminant animals, being able to use their feet only to sustain themselves, and having little strength in their jaws, which are used only in cropping and browsing the herbs, they are able to strike blows only with the head, directing one against the other with the top of that region. In their fits of rage, which are frequent, especially among the males, their "sentiment interieur," by these efforts directs more strongly the fluids toward that part of the head, and causes there a secretion of horny material in some, and of both osseous and horny material in others, which gives to them solid protuberances. This is the origin of horns and bosses, with which the greater number of these animals have the head armed. It is curious to observe the product of the habits in the peculiar form and the height of the giraffe (*Camelopardalis*). It is known that this animal, the tallest of mammals, inhabits the interior of Africa, and that it lives in places where the earth is almost always arid and without herbage, so that it is obliged to browse the leaves of the trees, and to force itself continually to reach them. It results from this long-continued habit, in all indi-

viduals of its race, that the front limbs have become longer than the hind ones, and that its neck is much elongated; that the giraffe, without rising on its hind feet, elevates its head and attains to six metres in height (nearly twenty feet).

Among birds, the ostriches, deprived of the faculty of flight, and elevated on very high limbs, truly owe their singular conformation to analogous circumstances. The result of habits is also as remarkable in carnivorous mammals as it is in the herbivorous, but it shows its effects in another way. In fact, those mammals who are habituated, as well as their race, to climb, to scratch, in order to excavate the earth; to rend, to attack; to put to death other animals which may be their prey, have had occasion to use their toes. Now, this habit has favored the separation of their toes, and on them has formed the claws with which we see them armed. Among the carnivores it is found that they are obliged to employ the chase to take their prey. Now, those of these animals who want, and consequently have the habit of rending with the claws, are compelled to force them deeply into the body of the other animal in order to hold it, and afterwards the effort made to tear the seized part has, by these repeated efforts, procured for those nails a size and a curve which would then have impeded them much in walking or running on stony ground. It results in this case that the animal has been obliged to make efforts to draw back these too projecting and crooked claws, and it results in, little by little, the formation of these peculiar grooves into which cats tigers, lions, etc., retract their claws when not in use. Thus, efforts in some directions, long-continued or habitually made by certain parts of a living body to satisfy wants caused by nature or by circumstances, increase these parts, and they acquire dimensions and a form which they would never have attained if these efforts had not become the habitual action of the animals which employ them. Observations made on all known animals would everywhere furnish examples of it. What is more striking than what the kangaroo offers us? This animal, which carries its little ones in the pouch which it has under its abdomen, has acquired the habit of holding itself upright, poised only on its hind feet and on its tail, and of moving only by the aid of a series of leaps, in which it preserves its upright attitude so as not to hurt its little ones.

Behold, then, what is the result? First.—Its front legs, of which it makes very little use, and upon which it supports itself only an instant when it leaves its upright attitude, have never acquired a development proportional to those of other parts, and have remained slender, very small, and almost without strength. Second.—The hind limbs, almost continually in action to sustain all the body, when leaping, have, on the contrary, attained a considerable development, and have become large and strong. Third.—Finally, the tail, which we see greatly employed in sustaining the animal, and in executing its principal movements, has acquired at its base a breadth and a force extremely remarkable. These well-known facts are assuredly well calculated to prove that which results from the habitual use by animals of an organ or of some part. If, when we observe in an animal an organ particularly developed, and strong and powerful, it is claimed that its habitual exercise has done nothing to produce that result; that its continued disuse makes it lose nothing, and that, finally, this organ has always been such as we find it since the creation of the species to which this animal belongs, I demand why our domestic ducks are not able to fly as the wild ducks; in a word, I will bring a multitude of examples to our notice, which will attest the differences resulting to us from the exercise or the lack of exercise of some of our organs, although these differences be not maintained in successive generations. In that case their results might be still more considerable. I observe, in the second place, that when the will determines an animal to some action, the organs which should execute this action are immediately excited by the influence of subtle fluids (of the nervous fluid), which becomes the determining cause of the movements which cause the action in question. A multitude of observations prove this fact. It results that the multiplied repetitions of these acts of organization strengthen, expand, develop, and also create the organs which are necessary. It is necessary only to observe attentively that which happens everywhere in this respect, to be convinced of the basis of this cause of the development of organic changes.

Now, all changes acquired in an organ in consequence of a habit employed sufficiently to have an effect, is preserved afterward by generation, if it is common to the individuals who in fecundation unite for the reproduction of their species. Finally this change is

propagated and passes thus into all the individuals which follow, and who are placed in the same circumstances, without which they would be obliged to acquire it in the same manner in which it has already been created. Moreover, in these reproductive unions, the mixture between individuals which have different qualities and forms, necessarily opposes the constant propagation of these qualities and forms.

I.—It is this which prevents in man, accidental qualities or defects due to circumstances to which he is exposed from preserving and propagating themselves by generation.

II.—If two individuals who have acquired peculiarities of form or defects be united, in this case they will reproduce the same peculiarities in successive generations. And if they restrict themselves to like unions, a particular and distinct race will then be formed. But the perpetual mixture between individuals which have not the same peculiarities of forms will destroy all the peculiarities acquired by particular circumstances. From this one can be assured that if distances of habitation had not separated men, the crossing, by generation, would have destroyed the general characters which distinguish different nations. If I should pass in review all the classes, all the orders, all the genera, and all the species of animals which exist, I would be able to show that the conformation of individuals and of their parts, that their organs, their functions, etc., etc., are everywhere only the result of circumstances in which every species finds itself surrounded by nature, and of the habits which the individuals which compose it have been obliged to adopt, and that they are not the result of an existing primitive form which has forced these animals to adopt their habits.

It is known that the animal which is called the Aï, or the sloth, (*Bradypus tridactylus*), is constantly in a state of so great feebleness that it executes very slow and limited movements, and that it walks with great difficulty on the ground. Its movements are so slow that it is claimed that it is able to take only fifty steps in a day. It is known also that the organization of this animal is in all respects harmonious with its condition of feebleness or its inability to walk, and that if it wished to make other movements than those which it is known to execute, it would not be able. If we sup-

pose that this animal has received from nature the organization which it possesses, we must believe that this organization has forced it to adopt the habits and miserable state in which it is found. I hesitate to believe thus, for I am convinced that the habits which the individuals of the race of the Aï have been forced to contract originally, have necessarily brought their organization to its present state. That since continual danger has formerly made the individuals of this species take refuge in trees, to live there habitually, and to sustain themselves there on their leaves, it is evident that they must be deprived of a multitude of movements which animals who live on the ground are in the habit of making. All the wants of the Aï have been then reduced to the hanging on the branches, to creeping, or to crawling to get the leaves, and afterwards to resting on the tree in a state of inactivity, and always to avoid falling to the earth. Besides, this kind of inactivity would be constantly encouraged by the heat of the climate; for, with animals of warm blood, heat predisposes them more to rest than to movement. Now, the individuals of the race of the Aï having for a long time preserved the habit of resting on trees, and of making only slow and little varied movements which suffice for their wants, their organization, little by little, would be brought into harmony with their new habits, and this would be the result: 1st.—That the arms of these animals making continual efforts to embrace easily the branches of the trees, will have lengthened; 2d.—That the nails of their toes will have acquired much length and a curved form by sustained efforts to cling; 3d.—That their toes, having only exercise in particular movements, will have lost all mobility, will have reunited, and will have preserved only the ability of bending or of straightening themselves altogether; 4th.—That their thighs, embracing continually the trunk and the great branches of the trees, will have contracted an habitual bowing, which will have helped to enlarge the pelvis, and to direct the cotyloid cavities backward; 5th.—Finally, that a great number of their bones will have consolidated, and that thus many parts of their skeleton will have acquired a tendency and a form appropriate to their habits, and contrary to those which they would have had under other habits.

No one is able to contest this, since nature, in a thousand other ways, constantly shows us analogous examples of the power of cir-

cumstances on the habits, and in that of habits on the forms, the disposition, and the proportion of the parts of animals. A great numder of citations being unnecessary, the point of discussion reduces itself to this. The fact is, that diverse animals have each, according to their genus and their species, particular habits, and always an organization which is perfectly in harmony with those habits. From the consideration of this fact it seems that one is at liberty to admit one or the other of the two following hypotheses, neither of which can be proved.

Conclusions admitted at this time: (1) Nature (or its Author, in creating animals has foreseen all possible kinds of circumstances in which they may have to live, and has given to each species a permanent organization, as well as a pre-determined form invariable in its parts; that it forces each species to live in the places and the climates where one finds them, and to preserve there the habits which it has. 2. My own conclusion: Nature in producing successively all species of animals, and commencing by the most imperfect or simple, to terminate its work by the most perfect, has gradually complicated their organization, and these animals, spreading themselves gradually into all habitable regions of the globe-each species has been subjected to the influence of the circumstances in which it is; and these have produced the habits which we observe and the modifications of its parts.

The first of these two conclusions is that which has been held to the present time, that is to say, it supposes in each animal a permanent organization and parts which have never varied and which will never vary; it supposes still that the circumstances of the places which each species of animal inhabits never vary in these places) for if they should vary, the same animals would not be able to live there, and the possibility of recognizing such elsewhere, and of going or transporting themselves there, would be denied them.

The second conclusion is mine. It supposes that, by the influence of circumstances on the habits and that which follows these habits on the organization, that each animal would receive in its parts and organization, modifications susceptible of becoming very consider able, and thus to have given origin to the state in which we find all animals. To prove that this second conclusion is without foundation, it is necessary to first prove that no point of the surface of the

surface of the globe has ever varied its nature, its exposure, its elevation, its climate, etc., etc.; and to prove farther that no part of an animal undergoes, after a length of time, any modifications due to change of circumstances and from the necessity which constrains them to a kind of life and of action different from that which has been habitual with them.

Now, if only one fact proves that an animal, after a long time of domestication, differs from the wild species from which it came, and if among the domesticated species there is found a great difference of conformation among individuals who have been subjected to a given habit, and those who have been constrained to adopt a different habit, then it will be certain that the first conclusion does not conform to the laws of nature and that, on the contrary, the second is perfectly in accord with them. All agree then to prove my assertion: that it is neither the form of the body nor of its parts which gives origin to the habits and the manner of life of the animals; but it is, on the contrary, the habits, the manner of life and all the other influential circumstances, which have, with time, constructed the form of the body and of the parts of the animals. With new forms new faculties have been acquired, and little by little Nature has come to form animals, such as we actually see them.

Can there be in Natural history a more important consideration and to which one should give more attention than that which I expound?

THE EVOLUTION OF MAMMALIAN MOLARS TO AND FROM THE TRITUBERCULAR TYPE.[1]

BY HENRY FAIRFIELD OSBORN.

THE dentition in the recent Mammalia is so diverse that the most sanguine evolutionist of fifteen years ago could not have anticipated the discovery of a common type of molar, in both jaws, as universal among the Mmamalia of an early period as the pentadactyle foot, and as central in its capacity for development into the widely specialized recent types.

The tritubercular molar, discovered by Professor Cope in the Puerco, is exactly such a type, and may be considered with the pentadactyle foot as playing a somewhat analogous rôle in mammalian history, with this important difference—the unmodified pentadactyle foot was probably inherited direct from the reptiles, and its subsequent evolution, with a few exceptions, has been in the direction of the greater or less *reduction* of primitive elements towards special adaptation, as, to borrow an extreme illustration, in the transition from *Phenacodus* with 26 elements in the manus to *Equus* with only 12 such elements. On the other hand, the tritubercular tooth was not inherited, but in all probability developed within the mammalian stock, from a hypothetical form with almost, if not quite simple conical molars, implanted by single fangs, in a nearly homodont series.[2] No such primitive type of mammalian dentition is actually known, although *Dromotherium* approximates it; but the apparent reversion to this type among the *Cetacea,* and apparent retention of it in the *Edentata,*[3] support all the independent evidence upon this point derived from the Mesozoic Mammals. The principle of growth was the regular addition of new parts to the simple cone, not at random, but according to a certain definite

[1] Read in the geological section of the British Association at Bath, September, 1888. Read in abstract by Prof. Cope, National Academy is Sciences, at New Haven, Nov., 1888.

[2] See Author "Structure and Classification of the Mesozoic Mammalia." Jour. Phila. Academy, 1888, p. 240.

[3] See Oldfield Thomas, "The Homologies and Succession of the Teeth in the Dasyuridæ." Phil. Trans., 1887, p. 458.

order which apparently progressed independently in different phyla, through a series of sub-tritubercular stages until trituberculy [1] was attained.

The tritubercular molar consists essentially of three cusps, forming what may be called the primitive triangles, so disposed that the upper and lower molars alternate. This, when attained, formed a central stage from which the great majority of recent molar types have diverged by the addition, modification and reduction of cusps; we must except the Monotremes, the Edentates, and possibly the Cetaceans, although there is considerable evidence that the cetacean molars were once of the triconodont type.[2] Among extinct orders, the Multituberculata (*Plagiaulax, Tritylodon*, etc.) must also be excepted from this series and discussion.

The almost universal predominance of trituberculy in the early geological periods, is very significant of the uniformity of molar origin. Of twenty known Mesozoic genera,[3] all except three [4] show trituberculy in some of its stages. As to the Lower Eocene, eighty-two Puerco species, representing twenty-six genera and five orders (Creodonta, Tillodontia, Lemuroidea, Condylarthra, Amblypoda), only four species have quadritubercular teeth, all the remainder are tritubercular.[5] Prof. Rütimeyer has recently pointed out the predominance of this type in the nearly parallel Egerkingen beds The contemporary Cernaysien fauna in the collection of Dr. Lemoine at Rheims, recently examined by the writer, shows exclusively tritubercular molars or their derivatives. By the Middle Eocene the lines of divergence towards the existing types of molars were well advanced, but trituberculy persisted in the dentition of several orders, in which it is found to-day (Lemuroidea, Insectivora, Carnivora, and many Marsupialia).

[1] First employed by Rütimeyer, "Ueber Einige Bezi ehungen zwischen den Säugethierstämmen Alter und Neuer Welt." Abh. d. schweiz. pal. gesellsch., Vol. XV., 1888, p. 54.

[2] See Brandt, "Die Fossilen u. Subfoss. Cetacean Europas." Taf. XXXII., figs. 4-9.

[3] The list given by the writer (op. cit., p. 247) is found to contain several synonyms. See "Additional observations upon the Structure and Classification of the Mesozoic Mammalia." Proc. Phila. Acad., Nov., 1888, p. 292

Dicrocynodon (Diplocynodon), Docodon, Enneodon, Marsh.

[5] Cope, "Synopsis of the Vertebrate Fauna of the Puerco Series," Am. Phil. Soc., 1888. p. 298.

It follows that it is quite as essential for the comparative anatomist to thoroughly grasp the meaning and history of each of the component cusps of the tritubercular molar and of their derivatives, as it is to perfectly understand the elements of the manus and pes. For, the homologies of the cusps can now be determined almost as certainly as those of the digits. Take a human molar, for example, every component tubercle has its pedigree, and it can be demonstrated, almost beyond a doubt, which of these tubercles is homologous with the single reptilian cone. The writer recently (op. cit., p. 242) proposed the adoption of a distinct nomenclature for the different cusps of the tritubercular molar, and offered a series of terms for the primary cusps based as far as possible upon the primitive position and order of development, and in most instances in accord with their secondary position. This nomenclature can be extended to the secondary cusps in the sextubercular superior, and quinquetubercular inferior molars. The terms now in general use are based, for the most part, upon the secondary or acquired position, and in no instance upon the homologies of the cusps in the upper and lower molars, or even in corresponding molars of different genera, thus involving much confusion. For example, the Antero-internal cusp of the lower molar of *Mioclænus* is not homologous with the antero-internal cusp of *Hyopsodus*, nor with the antero-internal cusps of the upper molar of either genus.

The present contribution is based principally upon the writer's studies among the Mesozoic Mammalia, and, with some additions, upon Prof. Cope's numerous essays upon the tritubercular type in the Tertiary Mammalia.[1]

Four propositions may be laid down for discussion:—

(1.) That trituberculy was acquired during the Mesozoic period, in a series of stages beginning with the single cone and attaining to the primitive sectorial type in the Jurassic period.

[1] Professor Cope's essays abound with discussions and notes upon the origin and succession of the tritubercular type. (See collection, in "Origin of the Fittest"). He has outlined the transition from the single cone to the tritubercular crown (p. 347); the tubercular sectorial (p. 246); the quadritubercular type (p. 245 and p. 359); the *Spalacotherium* molars as a transition to the *tritubercular* (p. 259). The acquisition of the superior and inferior quadritubercular molar (p. 361). The prediction of the discovery of Carnivora with triconodont molars (p. 365), and of the simple tritubercular type in both jaws (p. 362).

(2.) The majority of Mesozoic mammals showed trituberculy in some of its stages. Present evidence goes to show that the remaining, or aberrant types, if such existed, did not persist. The majority of the persisting forms of later periods were derived from the forms, with simple tritubercular molars, of earlier periods. It follows that trituberculy was an important factor in survival.

(3.) The definite homologies of the primary and to some degree of the secondary cusps in the upper and lower molars can be established.

(4.) The mode of succession of tooth forms favors the kinetogenesis theory advanced by Ryder and Coope.

There are three general observations to be made:—

First.—In attempting to complete the history of each of the cusps, we naturally find that the palæontological record is not sufficiently perfect to admit of our following a certain type along a single phylum back to the primitive type. We must at the outset proceed upon the principle of similar effects, similar causes. For example, since the history of the development of the intermediate tubercles in the superior molars of the Lemuroidea (Pseudolemuroidea, Schlosser) is perfectly clear during the Wasatch and Bridger epochs—it is safe to infer that the intermediate tubercles of the Ungulate molars, which are fully developed in the underlying Puerco, had the same history. *Second.*—There are in each period *Aberrant types* which embrace either incomplete or degenerate tritubercular stages, *i.e.*, a high specialization in which the past record is obliterated, or, finally, stages in non-tritubercular lines of development. *Third.*—In the parallel evolution of trituberculy in different phyla we find that the progression is by no means uniform. In every geological period in which the fauna is well known we observe *progressive* genera which outstrip the others in reaching a certain stage of molar development, contrasted with *persistent* types which represent arrested lower stages of development, while between them are the *central* types which represent the degree of evolution attained by the majority of genera. The latter may be said to constitute the stage which is characteristic of the period.

The Stages of trituberculy may now be defined as seen in different types in their order of succession:—

I. *Haplodont* Type (Cope).[1] A simple conical crown. The fang usually single and not distinguished from the crown. This type has not as yet been discovered among the primitive Mammalia.

A *Protodont* Tub. Type.[2] The crown with one main cone, and lateral accessory Cuspules; the fang grooved. There is some question as to the advantage of distinguishing this as a type, for it stands intermediate between types I. and III. Example, *Dromotherium* of the American Triassic.

II. *Triconodont* Type (Osborn, op. cit., p. 242). The crown elongate, trifid, with one central cone and two distinct lateral cones The fang double. Example, *Triconodon.*

III. *Tritubercular* (Cope)[3]. The crown triangular, surmounted by three main cusps, the central cone placed internally in the upper mollars and externally in the lower molars. Example, the lower molars of *Spalacotherium* and *Asthenodon.* This type is rare in its primitive condition as above defined.

The upper and lower molars are alike in types I. and II.; in type III. they have a similar pattern but with the arrangement of the homologous cusps reversed. These types are all primitive. In the following sub types, the primitive triangle forms the main portion of the crown, to which other "secondary" cusps are added, the homologies of which in the upper and lower molars are somewhat doubtful. Parallel and with an intimate relation to the addition of the secondary cusps, is the division of the tritubercular into a secodont and bunodont series, according to the assumtion ol a purely cutting or crushing function. In departing from the primitive type, the upper and lower molars diverge in structure, and the homologies of the secondary cusps in each are somewhat doubtful.

LOWER MOLARS.

A. *Tubercular Sectorial,* sub type (Cope). *a.* The primitive

[1] "The Homologies and Origin of the Types of Molar Teeth in the Mammalia Educabilia." Journ. Phila. Acad., 1874. The term *Homodont* was previously applied to this type by Rütimeyer, "Odontographie der Hufthiere, etc." Verh. d. Naturforsch. Gesellsch. in Basel, Band. III., 1863, p. 563. In the writer's opinion this term has acquired a special significance as applied to a whole series of teeth, viz., the reverse of "heterodont," and may well be retained in this sense.

[2] Osborn, op. cit., p. 222.

triangle elevated and its cusps connected by cutting crests; a low posterior heel. *b.* This type embraces a *quinquetubercular* form in which the heel consists of two cusps, an internal and external.[1] *c.* In the Bunodont series it develops into the *quadritubercular* form, by the loss of one of the primitive cusps.

UPPER MOLARS.

B. *Tritubercular. a.* The primitive triangle in the secodont series purely tricupsid. *b.* This embraces a *quinquetubercular* form in which "intermediate" tubercles are developed, both in the Secodont and Bunodont series. *c.* In the Bunodont series a postero-internal cusp is added, forming the *sextubercular* molar.

NOMENCLATURE OF THE CUSPS—As above stated, there is no doubt about the homologies of the three "primary" cusps (protocone, paracone, metacone) in the upper and lower molars They may be given the same terms, with the arbitrary suffix *id*, to distinguish the lower cusps. The first "secondary" cusps (hypocone-hypoconid), added to the upper and lower molars of the primitive triangle, modify the crown from a triangular to a quadrangular shape, and hence may be considered homologous. The three additional secondary cusps (protoconule, metaconule, entoconid) evidently have no homology with each other.

TERMS NOW IN USE.	PROPOSED TERMS.[2]	ABBREV.
Upper Molars.		
Antero-internal cusp	Protocone.	pr.
Postero- " " or 6th cusp	Hypocone.	h.
Antero-external "	Paracone.	p.
Postero- " "	Metacone.	m.
Anterior Intermediate cusp	Protoconule.	pl.
Posterior " "	Metaconule.	ml.
Lower Molars.		
Antero-external cusp	Protoconid.	pr.
Hostero- " "	Hypoconid.	h.
Antero-internal cusp, or 5th cusp	Parrconid.	p.
Intermediate or antero-internal cusp (in quadritubercular molars)	Metaconid.	m.
Postero-internal cusp	Eutoconid.	e.

Evolution of the Cusps. The cusp evolution in the Mesozoic period has been fully discussed by the writer (op. cit., pp.240-4)

[1] American Naturalist, April, 1883, p. 407.

[2] I am much indebted to my colleagues Professors Macloskie and Winans for tie assistance in the selection of these terms.

PLATE XXV.

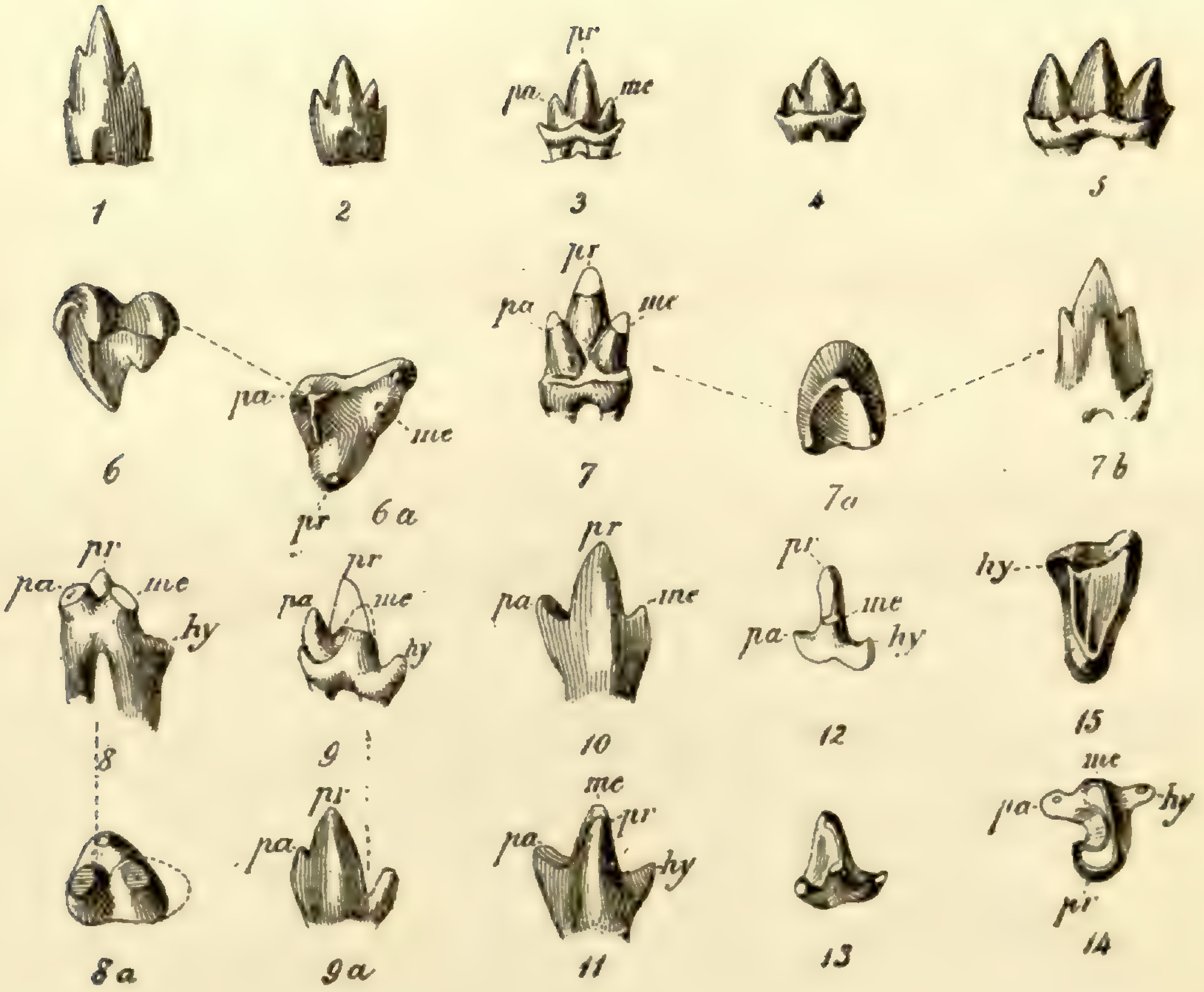


FIG. 1.

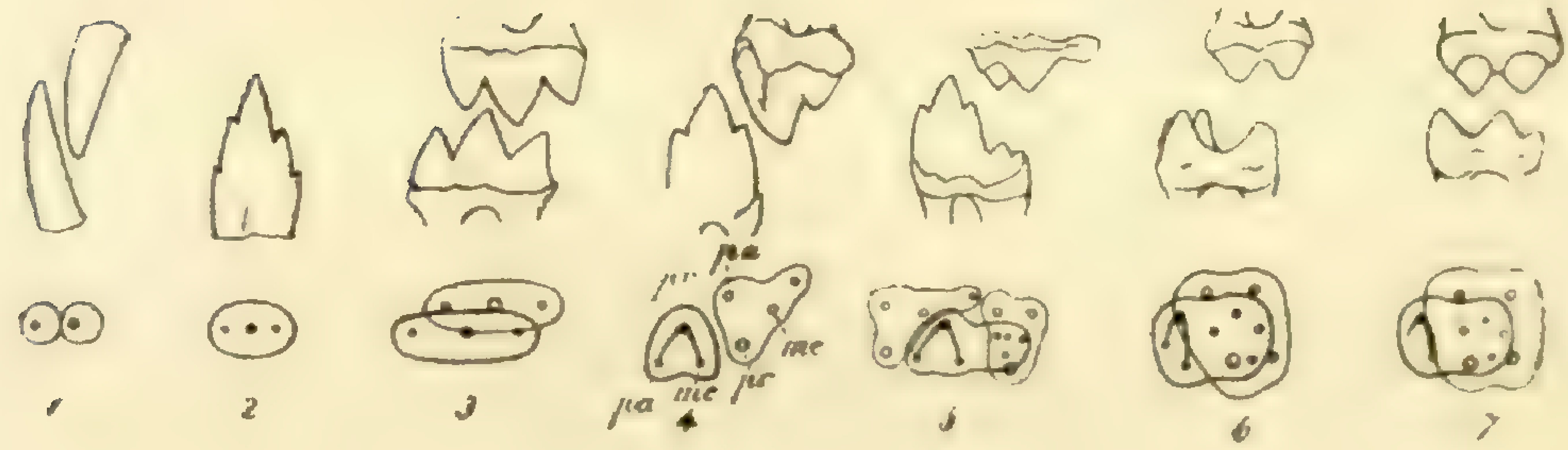


FIG. 2.

FIG. 1.—Molar teeth of Mesozoic Mammalia.
FIG. 2.—Molars of opposite jaws in normal mutual relation.

and in the Tertiary period, by Professor Cope, so that only a brief résumé is necessary here. In *Dromotherium* (fig. 1), from the upper Triassic, the oldest mammalian type known, with the exception

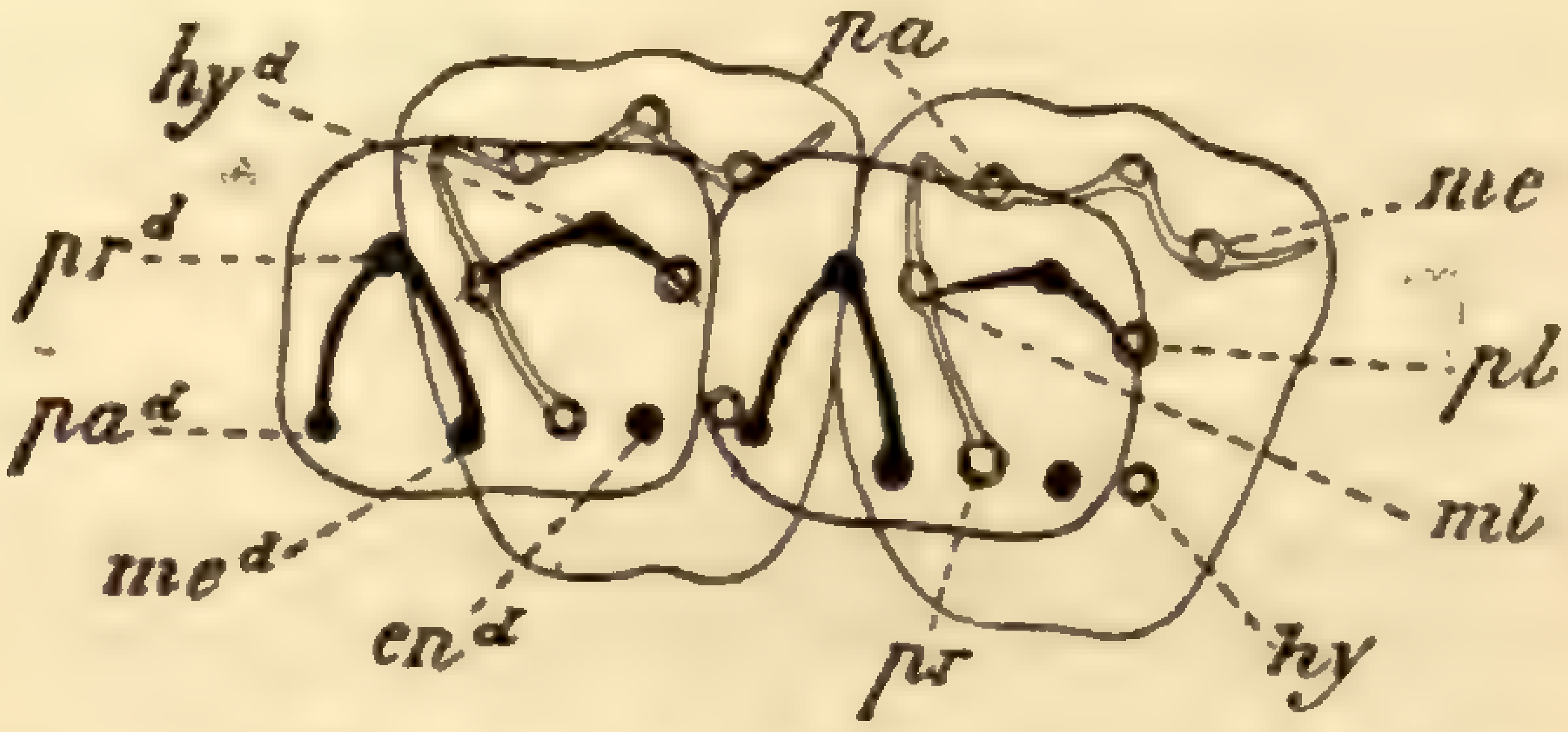


FIG. 1.—Diagram of quadritubercular molars of both jaws in normal mutual relation; the superior cusps double lines; the inferior black.

of *Microlestes*, the molars have a main protoconid with several minute lateral cuspules, differing in size in the different teeth, but in general giving a trifid appearance to the crown. The molars of the contemporary *Microconodon* (fig. 2) also have unpaired fangs, but distinctly trifid crowns, with the anterior and the posterior cusps, or para and metaconids, upon the slopes of the protoconid. This Triconodont type reappears, with the addition of a cingulum and paired fangs, in *Amphilestes* (fig. 3) and *Phascolotherium* (fig. 4) of the lower Jurassic and persists in *Tricondon* (fig. 5) of the upper Jurassic. In this succession we observe especially the relative subsidence of the protoconid and upgrowth of the para- and metaconids. Contemporary with *Amphilestes* is the classical genus *Amphitherium* (fig. 6). A recent examination of the type specimen by the writer revealed the very interesting fact that the molars of this genus are probably of the primitive tubercular-sectorial types,—the oldest known example. Only the paracone and metaconids and hypoconids have been observed heretofore, but one can see the tip of the main external cusps between the former pair. This pattern is repeated, with a considerable elevation of the heel, in *Peramus* of the upper Jurassic.[1] Neither of the two foregoing are of the primitive heelless tritubercular type which is apparently found in *Spalacotherium* also upper Jurassic, and in the nearly related if not synonymous *Peralestes*, Plate XXV. Contemporary with the above, are numerous genera of the *Stylodon* order; among these, *Asthenodon* is of

[1] This genus includes also *Septocladus dubius* Owen, and *Spalacotherium minus* Owen. See Proc. Phila. Acad., Nov. 1888, p. 292.

the primitive tritubercular type without the hypoconid, all the remainder present various modifications of the tubercular sectorial.

This covers our knowledge of tritubercu1y in the Mesozoic period. No bnunodont forms are known—they were probably developed during the Cretaceous, for a few are found well developed in the Puerco. In the Sectorial series many of the types do not widely depart from those seen in the Jurassic, but the Bunodont series are universally characterized by the initial or advanced development of the proto- and metaconules in the upper molars and the apperance of the *Entoconid* upon the inner side of the hypoconid below.

The principles governing cusp development.—It is remarkable to note in how many particulars the actual succession of molar development in the Mesozoic period coincides with the theoretical scheme of origin of trituberculy proposed by Cope[1] and supported by Wortman[2] several years ago. At that time *Spalacotherium* and the genera now embraced under the *Triconodontidæ* were the only Mesozoic mammals whose molar structure was fully known, and the views of these authors were partly speculative and partly deductive from recent dental anatomy.

Two hypotheses may be advanced to explain the evolution of the ritubercular type. The first is that the type has been acquired by the selection of accidental variations in the production of new cusps and modelling of old ones. The second is, that the interaction of the upper and lower molars in the movements of the jaws has resulted in local increase of growth at certain points, resulting first in new cusps, then in a change of position and of form in the cusps. Both hypotheses are open to numerous objections and are by no means mutually exclusive, but the whole subject is so complicated as to require a separate treatment. The balance of evidence in tritubercular evolution seems to favor the second or kinetogenesis theory—as apparently witnessed in two laws of cusp development.

I. The primary cusps first appear as cuspules, or minute cones,

[1] "The Evolution of the Vertebrata Progressive and Retrogressive," American Naturalist, April, 1885, p. 350.

[2] "The Comparative Anatomy of the Teeth of the Vertebrata," 1886 p. 418.

at the first points of contact between the upper and lower molars in the vertical motions of the jaws.

II. The modelling of the cusps into new forms, and the acquisition of secondary position, is a concomitant of interference in the horizontal motions of the jaws.

The second law applies especially to the evolution of the molars after the acquisition of the tritubercular stage, and has been ably proposed and supported by Ryder,[1] principally in its application to recent types of teeth. The first, although not heretofore distinctly formulated, is partly founded upon facts and principles advanced by Cope, and applies chiefly to the stages which have been discussed in this essay.

During the Homodont mammalian or sub-mammalian molar stage, the jaws were probably isognathous and the simple cones alternated as in the *Delphinidæ* (fig. 1). The first additions to the protocone appeared upon its anterior and posterior surfaces. The growth of the para- and metaconids involved anisognathism,[2] for we find in the later triconodonts that the lower molars closed inside of the upper (*Triconodon*, fig. 2). There are several transition forms such as *Tinodon* and *Menacodon* between the primitive triconodont type and *Spalacotherium*, and it has been assumed by Cope and the writer (op. cit., p. 243) that the para- and metaconids were first formed upon the anterior and posterior slopes of the protoconid and then rotated inwards, but it is also possible that they were originally formed upon the inner slopes. In the complemental formation of the upper and lower triangles the jaws remained nearly isognathous (fig. 4). There is no evidence as to the origin of the hypoconid, which as a rule preceded the hypocone, as it was developed very early. In the *Stylacodontidæ*, *Phascolestes*, *Amblo-*

[1] "On the Mechanical Genesis of Tooth Forms." Proc. Phila. Acad., 1878, p. 45.

[2] As employed by Ryder (op. cit., p. 45). "So as not only to indicate respectively parity and disparity in transverse diameter of the crowns of the upper and lower molars, but also the parity or disparity in width transversely, from outside to outside," etc.

It is clear that in the homodont condition, with the teeth simply piercing the food, the greatest comminution (of the food) is effected by isognathism; in the triconodont stage, the jaws must be anisognathous to close upon each other, but the tritubercular stage admits a return to isognathism by the alternation of the triangles.

therium, etc., the crowns rapidly increased in transverse diameter (fig. 7) and, in some genera, they (Kurtodon) so far lost the tritubercular aspect that, but for the connecting form *Asthenodon* (fig. 6), we might hesitate to place them in this series. The key to the further evolution of the crown is seen in the bunodont series during the lower Eocene period.

The superposition of the lower and upper molar patterns brings out many interesting facts. First, even in the complex crowns of the bunodont molars the primitive triangles retain their primitive alternating arrangement. Second, the jaws are somewhat anisognathous. Third, in support of the first law of cusp development, we observe that the protoconule and metaconule are developed at the points of contact with the ridges which extend from the hypoconid, and, secondly, that the hypocone appears at the point where the paraconid abuts against the protocone. It follows from a comparison of numerous species of *Pelycodus* and *Mioclœnus* that as the hypocone develops, the paraconid recedes, as first observed by Cope; a fact difficult to reconcile with the kinetogenesis theory. In this manner the inferior primitive triangle is broken, as the upper molars develop into the sextubercular and the lower into the quadritubercular type. The complemental development of the upper and lower molars in the known genera of successive horizons is approximately displayed in the subjoined table.

The Eocene list of genera will be greatly reduced, especially in the Tritub.-tuberc-.sectorial type, when the upper and lower jaws are found associated, and it must be clearly understood that the sub-types a, b, c, in the above table, are very closely related by transition forms. In fact, in the carnivorous forms, the extreme secodont and bunodont types are frequently seen side by side, as in the first and second inferior molars of *Didymictis*. The chief distinction between these two series is the greater development of the secondary cusps and the almost invariable loss of the paraconid in the latter; this is effected by the broader surfaces of contact in the bunodont crowns. In the secodont series, on the other hand, the development of the secondary cusps is subordinated, and the metaconid is almost invariably suppressed.[1]

[1] See Cope: "Origin of the specialized Teeth of the Carnivora." Am. Naturalist, March, 1879.

PLATE XXVI.

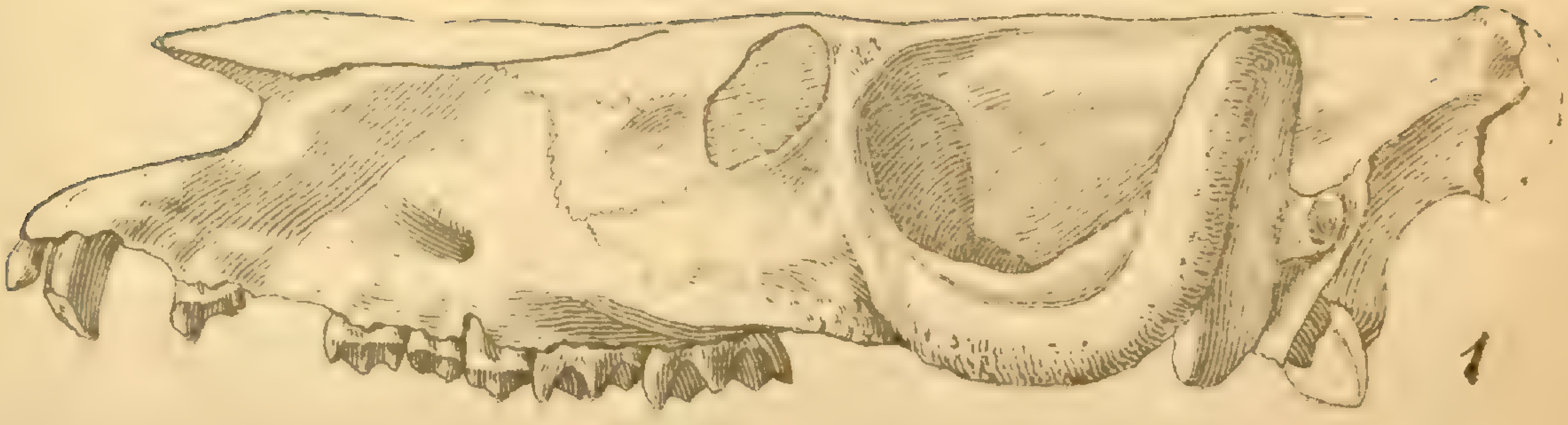


FIG. 1.—*Merycochœrus macrostegus* Cope.

FIG. 2.—*Merycochœrus superbus* Leidy.

		Secodont Series.			Bunodont Series.				
	I. A.	II.	III.	a.	a. c.	b.	c.		
Molars { Upper......	....	Tricono-dont.	Tritubercular.	Tritubercular.	Tritubercular.	Quinque-tuberc.	Sextubercular.	Aberrant.	Lophodont.
Molars { Lower......	Protodont	Tricono-dont.	Tritubercular.	Tuberc. Sectorial.	Quadritubercular.	Quinque-tuberc.	Quadritubercular.		Symborodont.
Middle Eocene,* Bridger..........	....	....	....	22	4	7	9	1	11
Lower Eocene,** Puerco..........	....	....	....	6	2	2	1	....	....
Upper Jurassic***....	....	3	2	5	....	....	....	4	....
Lower Jurassic.....	....	3	....	1	....	....	....	....	....
Triassic..........	1	1	....	....	....	....	....	....	....

* From Prof. Marsh's list of Bridger genera, excluding the Rodentia (see various papers). The Insectivora and Creodonta belong to sub-type a; the Lemuroidea, to sub-types b and c.
** From Prof. Cope's list of Puerco genera (see "Synopsis, etc.")
*** From Author's list of Mesozoic genera (see op. cit., p. 247).

Adapis and *Anaptomorphus* are examples of Sub-types a, c, associated; for it frequently happens that the paraconid atrophies without a complete enlargement of the hypocone. A study of the diagram demonstrates, however, that the association of Sub-types b and c is impossible. The recent monkeys *Tarsius* and *Loris* afford a good illustration of the association of tritubercular quinquetubercular sextubercular and quadritubercular molars.

The subsequent evolution of the molars, in different orders, was characterized, first, by the loss of the primary cusps, *e.g.*, the metaconid in the Carnivora,[1] the paraconid in the Ungulata. Second, by the loss of some of the secondary cusps, *e.g.*, the proto- and metaconules in the Artiodactyla.[1] Third, by the metamorphosis in the form of the cusps. This subject has been fully

[1] Schlosser: "Beitrage zur Kenntniss der Stammgeschichte der Hufthiere," Morph. Jahrb., 1886, p. 123, has especially drawn attention to the probability that the Artiodactyla were derived from sexitubercular forms.

treated by Rütimeyer, Kowalevsky, Cope, Schlosser and others.

The Relation of Trituberculy to the Persistence of Mammalian Phyla.—The above table shows somewhat indefinitely, but none the less positively, the general progression of the Mammalia, to and from the primitive tritubercular type. As already stated, even with our present very limited knowledge, certain stages appear to have been characteristic of certain periods, as follows: the triconodont in the lower Jurassic; the primitive tritubercular and tubercular sectorial in the upper Jurassic; the secodont and bunodont subtypes of trituberculy, predominated in the Puerco; in the Bridger, the Perissodactyl ungulates had mostly passed beyond into the lophodont and symborodont types, and the Artiodactyls were approximately in the stage of sub-types c; but the Lemuroidea, Creodonta, Insectivora, etc., were, almost without exception, tritubercular.

There can be little doubt that, parallel with the tritubercular forms, in each period, there were aberrant or degenerate types, but it is difficult to determine which these are. Many Mesozoic types, which the writer formerly considered aberrant, have now proven to be tritubercular.[3] The upper Jurassic genera included under the *Dicrocynodontidæ* (see Marsh, *Amer. Journ. Sc.*, April, 1887, p. 338) are apparently aberrant. There are several degenerate types among the Puerco and Wasatch Creodonts, such as *Dissacus* and *Mesonyx*. But there is a striking proof of the superiority of the tritubercular molar in the fact that, according to our present knowledge at least, the Jurassic mammals possessing aberrant or degenerate molar types did not persist into the Puerco, nor did such types in the Puerco persist into the Bridger. There is some doubt as to the persistence of the sub-tritubercular stage; the writer previously considered the *Thylacinus* molars as triconodont; but Mr. Lydekker has called attention to the probability that the metaconid has disappeared and been replaced by a heel as in the sectorial teeth of the Carnivora. The disappearance of the degenerate types may be attributed to the general principle that rapid specialization and loss of parts leads ultimately to extinction, by depriving the animal of the means of adaptation to new conditions, or surroundings.

[3] See "Additional Observations upon the Structure and Classification of the Mesozoic Mammalia." Proc. Phila. Acad., Nov., 1888.

The mechanical superiority of the tritubercular type, over every other has been repeatedly demonstrated in its plastic capacity of adaptation to the most extreme trenchant and crushing functions.

THE ARTIODACTYLA.[1]

BY E. D. COPE.

THE Artiodactyla is the suborder of the Diplarthrous Ungulata in which the astragalus articulates with the second row of tarsal bones by a ginglymus or hinge, and in which the third and fourth toes are equally or subequally developed.[2] It includes the most highly modified of the Mammalia, whether we regard the organs of locomotion or of digestion. The antelope and deer illustrate the greatest speed to which the mammal has attained. Their extraordinary apparatus for the digestion of vegetable substances which contain but a small percentage of nutritious proteids, has given them an extraordinary advantage, so that they are after the rodents, the most abundant of their class, in spite of the persistent persecution of the carnivorous species. They attain in the genera Giraffa and Bos the largest dimensions in the class, excepting only the Proboscidia.

The Artiodactyla make their first appearance in the early or Wasatch Eocene in the genus Pantolestes Cope. A genus exists at a corresponding horizon in Europe. No other genus of the suborder appears with it. Its representatives steadily increase in numbers in the succeeding Bridger and Uinta epochs in America, and in the Calcaire grossier and Gypse of Europe. Some of these, *e.g.*, the Anoplotheriidæ of Europe, diverge from the line of succession, while others, *e.g.*, Xiphodontidæ, are clearly ancestors of later forms. In America, the Pantolestidæ appear as ancestors of the Camels especially. I now give a synopsis of the families of the suborder and their phylogenetic relations.

I. Superior molars tritubercular (Pantolestoïdea).

Molars bunodont; four digits............................*Pantolestidæ.*

[1] Modified for the Naturalist from a paper by the author in the Proceeds. of Amer. Philos. Society, 1887, p. 377.

[2] See Naturalist, November, 1877.

II. Superior molars quadritubercular with an intermediate fifth.

1. Three digits (Anoplotheroïdea).

Intermediate tubercle anterior.......................... *Anoplotheriidæ.*

11. Two or four digits (Anthracotheroïdea).

A. The intermediate tubercle posterior.

Four digits; molars bunodont.............................. *Dichobunidæ.*

Four digits; molars selenodont............................ *Cænotheriidæ.*

AA. The intermediate tubercle anterior.

Four digits; one series of V's below............... *Anthracotheriidæ.*

Two or four digits; two series of V's below......... *Xiphodontidæ.*

III. Superior molars quadritubercular, without an intermediate fifth.

A. Molars bunodont, or cross-crested, (Suoïdea).

Mandibular condyle triangular; no postglenoid process...... *Suidæ.*

Mandibular condyle subcylindric; a postglenoid process... *Hippopotamidæ.*

AA. Molars selenodont (with four crescents above).

a. Inferior molars with one series of crescents (Merycopotamoïdea).

Premolars unlike molars............................ *Merycopotamidæ.*

aa. Inferior molars with two series of crescents.

β. Superior premolars (except first premolar) with one crest (Cameloïdea).

γ. "Fourth premolar like molars below, with three crests above."

Two digits only (four? in Agriochœrus)............... *Dichodontidæ.*

γγ. Fourth premolar entirely different from molars.

δ. Navicular and cuboid bones distinct from each other.

ε. Superior incisors present.

No cannon bone; a vertebrarterial canal.............. *Oreodontidæ.*

No vertebrarterial canal; no cannon bone......... *Poëbrotheriidæ.*

No vertebrarterial canal; a cannon bone;........... *Protolabididæ.*

εε. No superior incisors (except incisor three).

No vertebrarterial canal; a cannon bone; superior p. m. iv with external and internal crests................................ *Camelidæ.*

Like Camelidæ, but superior p. m. iv a simple cone... *Eschatiidæ.*

δδ. Navicular and cuboid bones coössified.

PLATE XXVII.

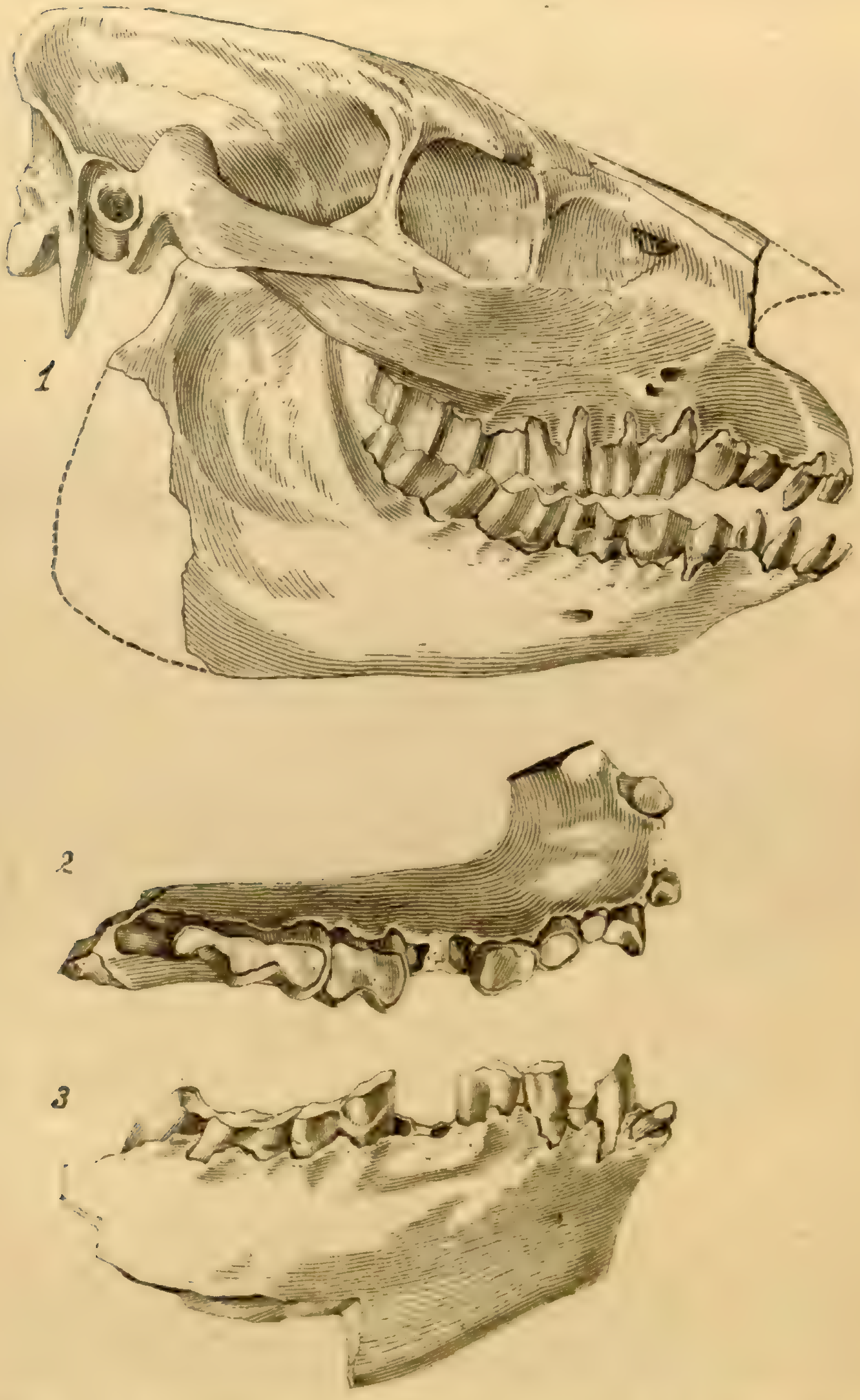


FIG. 1.—*Merychyus arenarum* Cope. $\frac{3}{4}$ 2-3. *Pithecistes facies* Cope. $\frac{3}{4}$

All premolars but No. iv without internal crescent ...... *Tragulidæ.*

ββ. Superior premolars 2-3-4 with internal as well as external crest; a naviculocuboid bone; no superior incisors (Boöidea).

Superior p. m. ii without internal crescent.................*Moschidæ.*
Superior p. m. ii with internal crescent.
Horns permanent, originating distinct from skull.........*Giraffidæ.*
Horns permanent, processes of the skull ....*Movidæ.*
Horns periodically shed ....*Cervidæ.*

Of the preceding sixteen families, ten are extinct. The six families with living representatives are the Suidæ, the Tragulidæ, the Camelidæ, the Moschidæ, the Cervidæ, the Giraffidæ, and the Bovidæ.[1] Thus none of the primary divisions, I and II, have recent representatives. But few of them in fact (some Cænotheriidæ and Anthracotheriidæ) survived the Eocene epoch. Division III is, on the other hand, characteristic of Miocene and recent time, except that some specimens of Gelocus of the Tragulidæ have been found in Upper Eocene beds. Several genera of Tragulidæ, with Elotherium and Poëbrotherium and Oreodon, belong to Oligocene beds.

Tubercular or bunodont molars are of prior age to selenodont molars, phylogenetically speaking. Of the former, the tritubercular type, it has been already shown, is ancestral to the quadritubercular type. Pantolestidæ are then clearly ancestral to all known Artiodactyla, and are themselves probably the descendants of the lost Amblypoda Hyodonta, whose existence I have anticipated on hypothetical grounds. Of the remaining families which are constructed on the quadritubercular basis, there are two types, as represented in divisions II and III of the preceding table. The intermediate or fifth lobe is especially characteristic of Eocene Artiodactyla. The intermediate tubercles exist in the Pantolestidæ, and one of them is preserved in the families of division II; but in group *A* it is the posterior one, and in group *AA* it is the anterior one. In the Suidæ and Hippopotamidæ, which are permanently bunodont, the intermediates are either lost or so divided as to lose their distinctive

[1] Antilocapra is sometimes separated from the Bovidæ as the type of a family, because it is said to sometimes shed its horny horn-sheath. This character, were it really normal, has no significance sufficient for the establishment of a family division.

character. In Elotherium traces of both the intermediates are visible, but they are obscure. The genetic relations of the families with five lobes to those with four are supposed by Schlosser to be direct and ancestral. This looks probable in the case of the Merycopotamidæ of the latter group, which has inferior molars like those of Hyopotamus of the former group. Whether the remaining families of division III *AA* (see table) (four-lobed) came off from the families of division II (five-lobed) is uncertain. It is probable that the fifth and sixth (or intermediate) tubercles were present in all primitive Artiodactyla, but they may have been lost, as in the Suidæ, in the bunodont stage, which gave origin to III *AA*, so as to be wanting from the earliest four-lobed selenodont ancestors. Of the two types of II (Anthracotheroïdea) the division *A* is supposed by Schlosser to have been the ancestor of the true selenodonts (III *AA*), but excepting in the case of Merycopotamidæ, this has not yet been demonstrated. Scott suspects with reason that the quinquetubercular Protoreodon is the ancestor of the quadritubercular Oreodon.

Leaving this debatable question, I refer to the family of the Anoplotheriidæ. The remarkable structure of the feet discovered by Gervais, and shown by Schlosser to belong to this family distinguishes it at once from all families of this and all other orders.

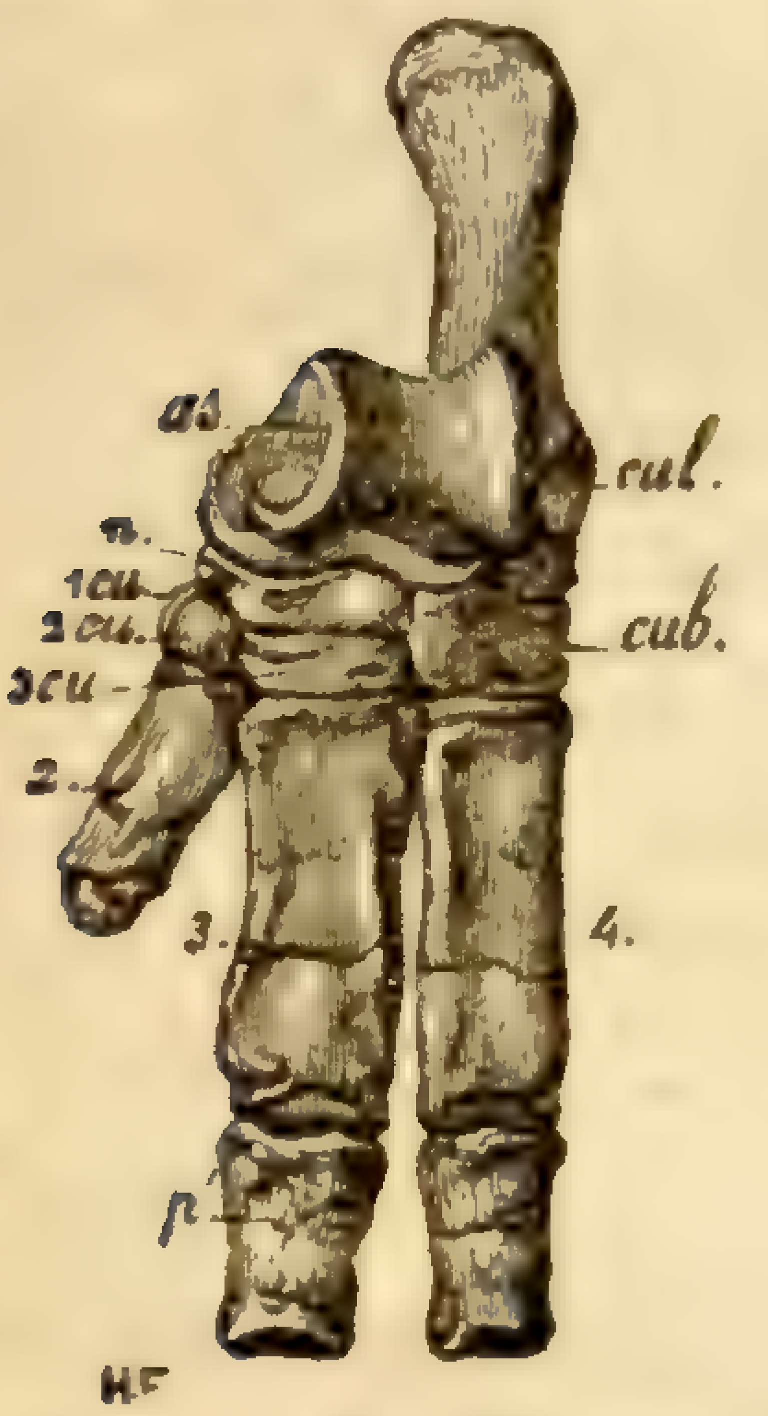


FIG. 1.—Right posterior foot of *Anoplotherium latipes* Gerv. ⅛ nat. size. *Cal.*, Calcaneum; *As.*, astragalus; *Cub.*, cuboid; *Cu.*, cuneiforms.—From the Eocene of Debruge; from Gaudry, Enchainment du Monde Animal.

The second digit is well developed in both feet, and stands inwards at a strong angle to the other toes. A rudimental fifth is present in the manus, but not in the pes. The latter is therefore tridactyle. The third and fourth digits are equal in the pes, but the third exceeds the fourth in the manus, giving an entirely perissodactyle character. Some didactyle forms have been placed in this family, but this is inadmissible on ordinary taxonomic principles. The divergent inner toe is supposed to have supported a web, useful in an aquatic life. As remarked by Schlosser, the origin of the Anoplotheridæ is entirely obscure as yet, the only ancestor yet known being the Pantolestidæ. It is probable that some unknown member of the Anthracotheroidea, which had bunodont teeth, may

form one of the missing links. Cebochœrus offers the proper type of dentition, and the number of toes (four, Schlosser) is also appropriate, but whether there are any structural obstacles to its being ancestral to the Anoplotheriidæ I do not know.

Anthracotheriidæ can be properly supposed to have descended from a type of Pantolestidæ with well-developed lateral toes, by the addition of the fourth tubercle, and the loss of the posterior intermediate; while the Dichobunidæ have had the same origin, the posterior intermediate cusp being preserved. The Xiphodontidæ may be supposed to have come off from the Anthracotheriidæ by the usual process of diminishing the lateral digits and developing both sets of crescents in both superior and inferior molars. This family carried the specialization of the five tubercled type farther than any other.

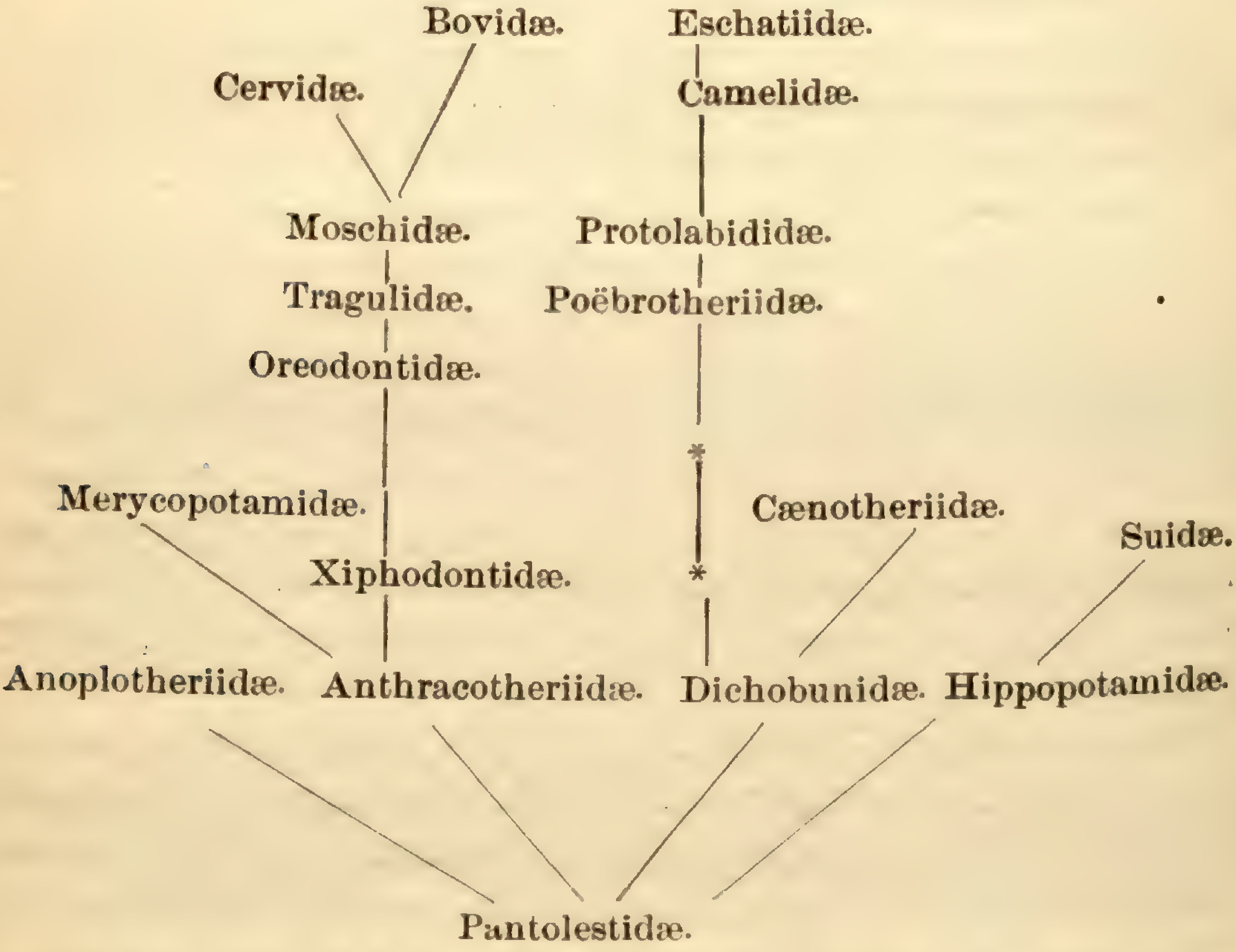
The Suoïdea have come off from the Pantolestoïdea by the addition of the fourth (posterior internal) tubercle to the superior molars. Some genus with better developed lateral (second and fifth) digits than Pantolestes must have been the ancestor. Such a form will be discovered. It has been already anticipated by Schlosser.[1]

It is a circumstance confirmatory of the view that the Cameloïdea and Booïdea are descendants of the Anthracotheroïdea rather than of the Suoïdea, that no genus of the latter superfamily shows the least tendency to assume a selenodont structure of the molars. It is therefore not unlikely that the two groups named may have had the history of the Merycopotamoïdea already referred to. They did not probably come from the Merycopotamoïdea themselves, since the geological age of the latter is too late. Of course, however, members of this group may be yet discovered in earlier formations.

The problems of the phylogeny of the remaining groups are less difficult, and have been largely solved by the investigations of Kowalevsky and Schlosser. Tragulidæ have been derived from Oreodontidæ with simpler premolar teeth than the typical forms, (*e.g.*, Dorcatherium and Lophiomeryx). In turn they have given origin to primitive Bovidæ (Cosoryx) through Gelocus, which have then branched off into specialized Bovidæ on the one hand, and

[1] Morphologisches Jahrbuch, 1886, p. 77.

Cervidæ on the other. The Poëbrotheriidæ have originated, from some family with diminished lateral digits, perhaps the Dichobunidæ, various intermediate genera being yet unknown. They are the direct ancestors of the Protolabididæ, the camels, and the Eschatiidæ. These relations may be expressed in the following table:—



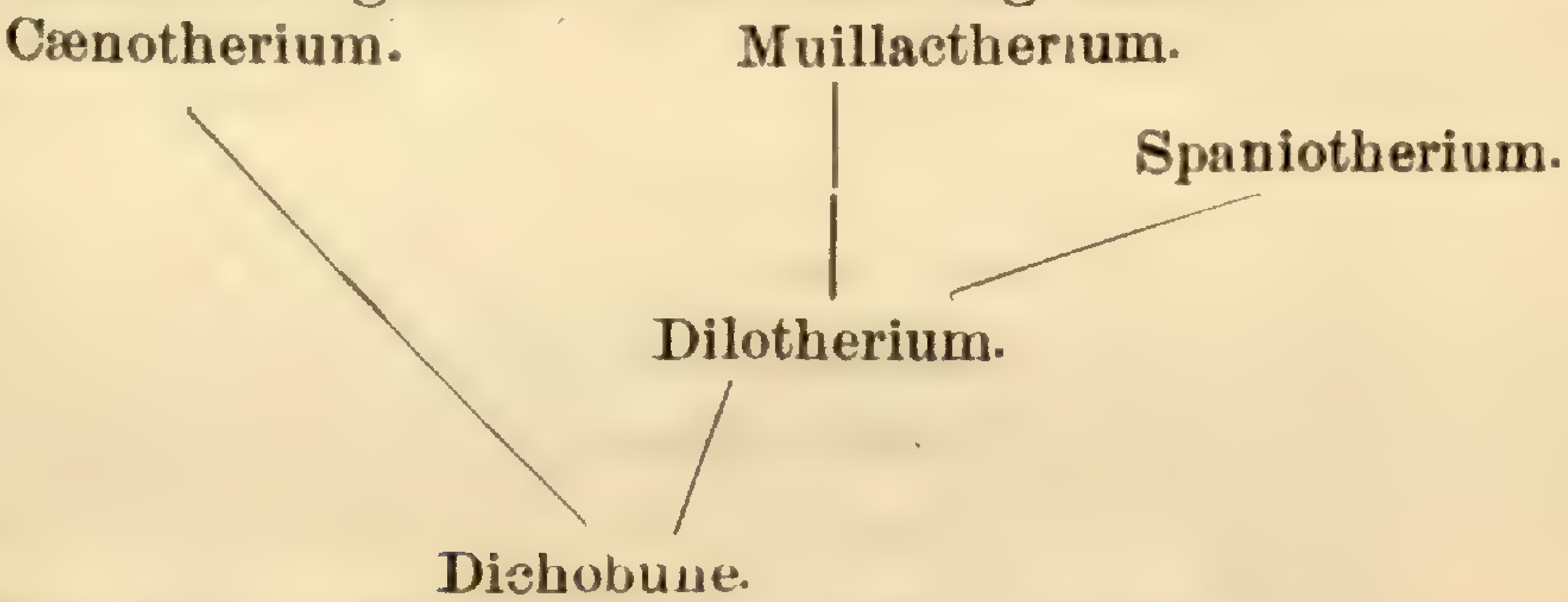
Of PANTOLESTIDÆ but one genus is known. The premolars are all simple in the upper jaw, except the fourth, which has one external and one internal tubercle. Six species are known from the Bridger and Wasatch Eocines of N. America. (FIG. 2.)

The structure of the premolars in Anoplotherium is complex for so primitive a type, and the third superior has an internal crest as well developed as in some of the Boöidæ. To the ANOPLOTHERIIDÆ are referred, besides Anoplotherium, Diplobune of Fraas and Dacrytherium, Mixtotherium and Mixochœrus of Filhol. But the structure of the feet of the latter genera is unknown. In Mixtotherium the fourth premolar is more, and the others less complex than in Anoplotherium. (FIGS. 1, 3.)

The known genera of DICHOBUNIDÆ are Dichobune of Cuvier, with Spaniotherium and Dilotherium of Filhol, in which the inter-

mediate tubercles are less developed than in Dichobune. They are related to the twe selenodont genera of CÆNOTHERIIDÆ, Cænotherium and Muillactherium. The latter differs from the former in the absence of the intermediate crescent from the last superior molars. The species of Cænotherium differ in the absence or presence of a short diastema in the dental series, and in its position in the lower jaw, whether behind the first or secondpremolar. (FIG. 4.)

The Dichobunid bunodont genera are ancestral to the Cænotheriid selenodont genera in the following fashion :—



This family terminated with the selenodont genera, which, as Schlosser remarks, left no known descendants.

THE ANTHRACOTHERIIDÆ present but few varations. Four genera are known, which differ as follows :—

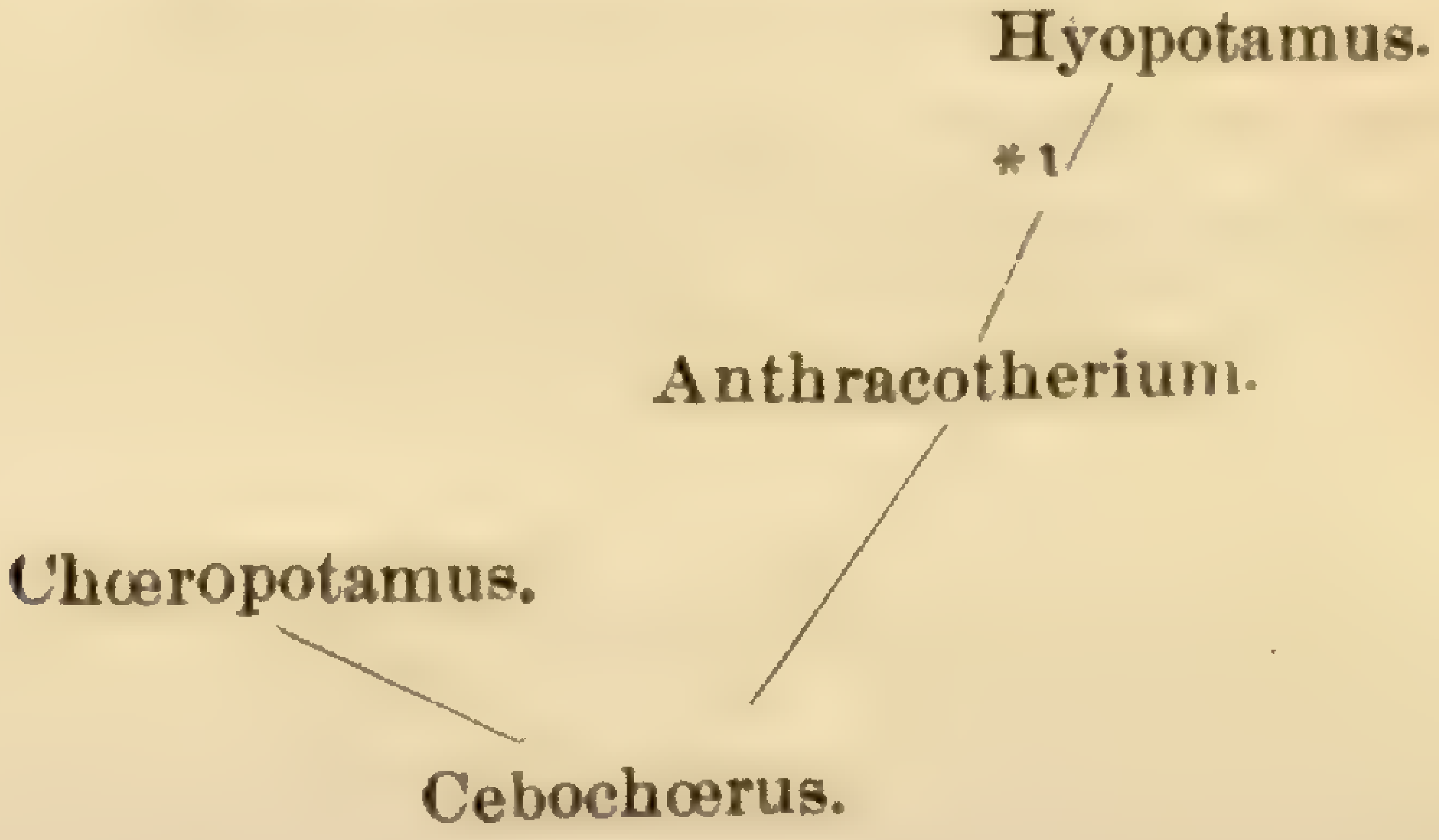
Entirely bunodont ; no diastemata ; canines developed. *Cebochœrus* Gerv.

Cusps of superior molars little flattened ; diastemata ; canine large. *Chœropotamus* Cuv.

Cusps of superior molars flattened ; no diastemata ; canines large. *Anthracotherium* Cuv.

Cusps of superior molars crescentoid in section ; diastemata ; canines large in males............................. *Hyopotamus* Owen.

The three genera last named cannot, as Schlosser remarks, be related in direct lines, but through common ancestors ; as may be shown thus :—



All the known species of this family are Old World excepting the single *Hyopotamus americanus* of Leidy. The genera Cebochœrus and Chœropotamus are from the Eocene, while the remaining two genera are of Miocene age. Some of the Anthracotheriums equaled the Rhinoceros in size, and were powerful beasts, well armed with formidable canine teeth. The species of Hyopotamus were on the other hand, of inoffensive character and had narrow compressed muzzles like the lamas, but more generally elongate.

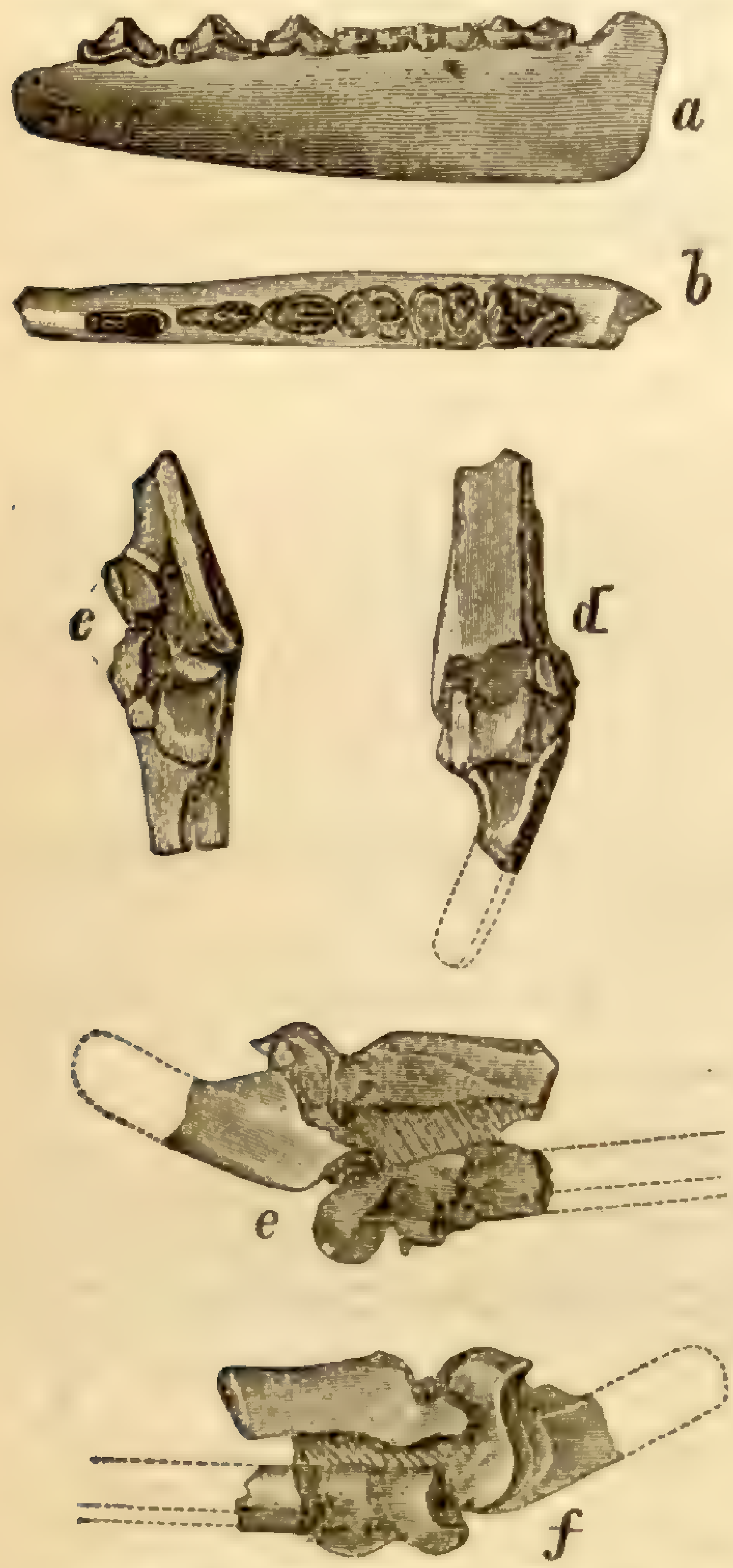


FIG. 2. — *Pantolestes brachystomus* Cope. Nat. size. From the Wasatch Eocene of Wyoming, N. A. Figs. *a*, *b*, mandibular ramus with teeth; *c*. *f*, tarsus, and parts of tibia and metatarsus.

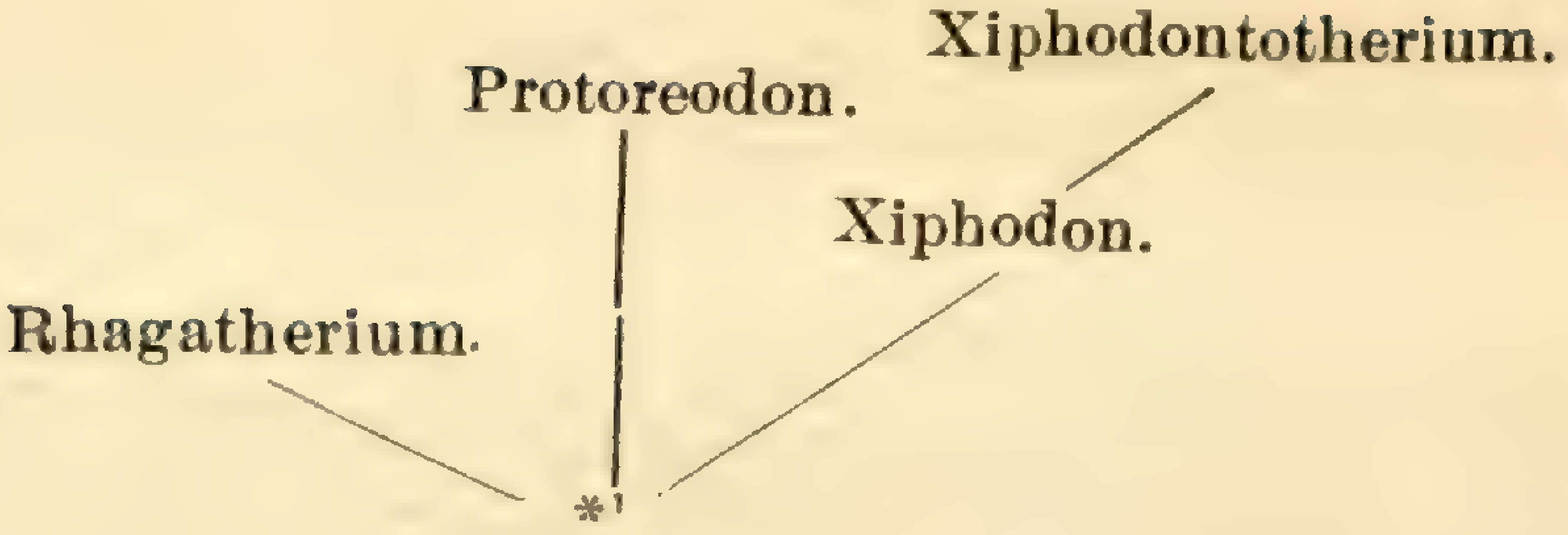
The ancestral genus is bunodont, without diastemata, and with well-developed canines. The hypothetical genus (1) is selenodont, with short diastema, and well-developed canines.

The certainly known genera of the XIPHODONTIDÆ are four, which differ as follows:—

Molars bunodont; diastemata; canines large......*Rhagatherium* Pict.
Molars selenodont; diastemata; canines medium........................ *Xiphodontotherium* Filh.
Molars selenodont; no diastemata; canines not distinct in form......... *Xiphodon* Cuv.
Molars selenodont; no diastemata; superior canine developed; inferior p. m. 4 functioning as canine. *Protoreodon* S. and O.

Cryptomeryx Schl. probably belongs here.

The relations of these genera are clearly somewhat like those of the preceding family. The bunodont condition of the molars of Rhagatherium is primitive, while its diastemata are the reverse: The continuous dental series of Xiphodon is primitive, while the detailed structure of the molars is advanced. These relations may be thus shown:—



The hypothetical genus 1 is simply a bunodont without diastemata, and with well-developed canines.

The genera of this family are Old World, except Protoreodon, which is North American. The *Xiphodon gracilis* Cuv. is one of the most abundant species of the Gypse of Paris and its equivalents. The restoration of Cuvier shows it to have been a graceful animal, with slender legs and neck. In Prootreodon S. and O. we first see the enlargement of the fourth inferior premolar (first olim) to function as a canine, which afterwards became such an important character of the Oreodontidæ. Probably two species are known, both from the Uinta formation of Utah; the type, *P. pavous* Scott and Osborn, being about the size of a raccoon.

FIG. 3.—*Anoplotherium caylusense.* Lyd part of right maxilla with molars, from Upper Eocene of Claylux France. Nat. size. From Lydekker.

The Hippopotamidæ embraces a considerable variety of genera, which are spmetimes arranged in separate families. They are as follows:—

I. Digits four.

A. Metapodials distinct, distally keeled behind only; inferior incisors straight, subcylindric (Hippopotaminæ).

Six lower incisors; orbit closed............*Hexaprotodon* Caut. Falc.
Four lower incisors; orbit closed..............*Hippopotamus* Linn.
Two lower incisors; orbit not closed.................*Chæropsis* Leidy.

AA. Metapodials distinct; inferior incisors normal (Hyotheriinæ).

Canines small, the inferior not received into a notch of the upper jaw; premolars $\frac{4}{4}$; fourth with two external tubercles;
Hyotherium von. M.

Canines large, the inferior received into a deep excavation in front of the superior canine; premolars $\frac{4}{4}$; fourth with one lubercle; *Bothrolabis* Cope.

Like Bothrolabis, but premolars $\frac{3}{3}$............ *Chœnohyus* Cope

II. Digits three.

I. Metapodials fused proximally (Dicotylinæ).

a. Premolars like molars; a deep notch in front of superior canine.

Premolars $\frac{3}{3}$; cusps of molars separate.................. *Dicotyles* Cuv.

Premolars $\frac{3}{3}$; cusps of molars united into partial cross-crests *Platygonus* Lec.

III. Digits two (Elotheriinæ).

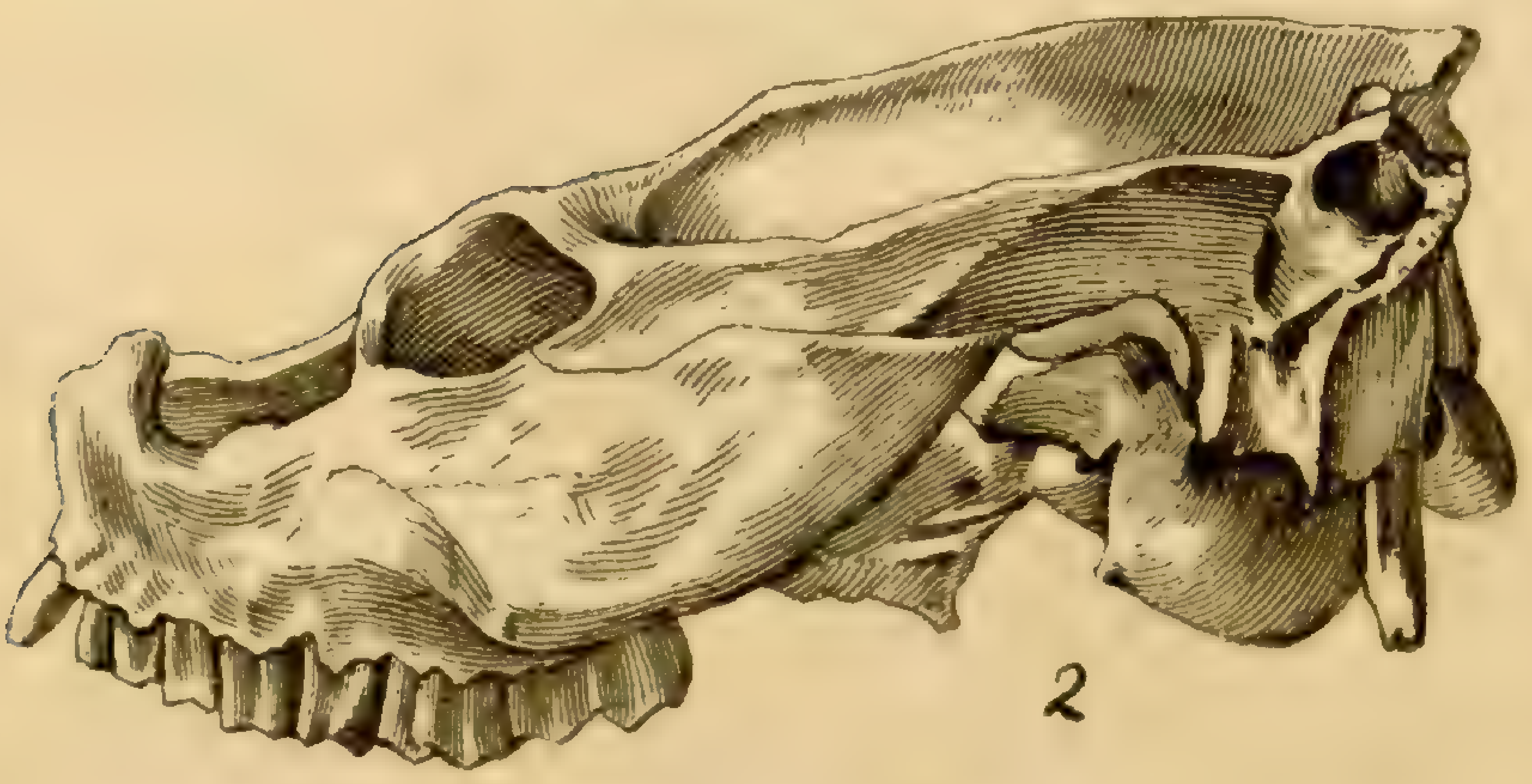
Superior canines decurved; last inferior molar without heel; *Elotherium* Pom.

FIG. 4.—*Cœnotherium filholi* Lydekker, superior and inferior views of skull, from the Eocene of Caylux, France. Natural size. From Lydekker,

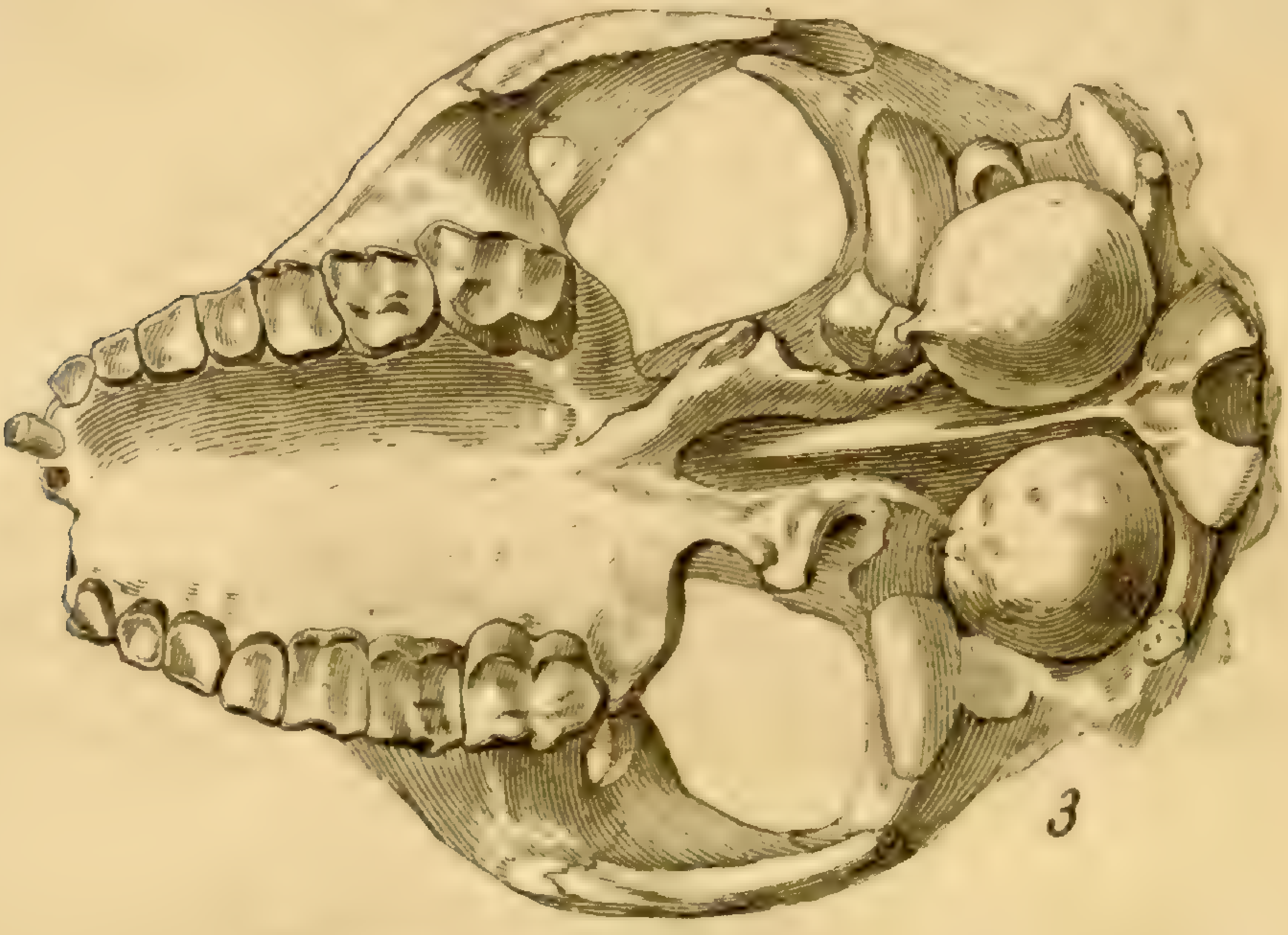
The genera of Hippopotaminæ are all Old World. While a single living species represents each of the genera Hippopotamus and Chœropsis, there are several extinct species of Hippopotamus and Hexaprotodon. These are chiefly confined to the Upper Miocene

PLATE XXVIII.

1



2



3

Cyclopidius emydinus Cope.

of India, but a species has been found in Algerian deposits, and a large form, *Hippopotamus major*, is abundant in the Plistocene of Southern Europe. Of the Hyotheriinæ the most generalized form, Hyotherium, is represented by several species in Europe and India. In its characters it is the most primitive of the family excepting in the weakness of the canine teeth. It is nearer the ancestral genus of the family than any that is yet known. In Bothrolabis we have a distinct approach to Dicotyles, of which it is probably the ancestor. Four species from the John Day or Middle Miocene of Oregon are known. They were of the sizes of the existing peccaries. The genus Platygonus embraces extinct species of North America and Mexico. *P. vetus* Leidy has left remains in the Pennsylvania Bone Caves. It was larger than the white-lipped peccary. *P. alemani* Dugés has been found in Mexico.

Several extinct species of Dicotyles are known, from the North American Plistocene and ? Pliocene. One of them, *D. nasutus* Leidy, has a more elongate muzzle than any of the recent species.

The Elotheriinæ embrace the oldest known forms of the family, dating in geological time from the Lower Miocene or Oligocene, and terminating with the summit of the middle Miocene. But one genus is certainly referable here, the Elotherium of Pomel; but a second, Tetraconodon Falconer, may belong in the same group. As the feet of the latter are unknown, the affinities cannot be yet determined. It differs in the inferior dentition from Elotherium by the huge size of its premolar teeth. Elotherium is represented by species over the Northern Hemisphere. The *E. magnum* is the only one known from Europe. It was larger than the domestic hog. The *E. mortoni* Leidy of North America was about the size of that animal. Its remains are common in the beds of White River age. It was accompanied by a huge species, the *E. ramosum* Cope, which has a skull as large as the Indian Rhinoceros. In all the species of this genus the mandibular ramus has two osseous projections, one opposite the symphysis, and the other well behind it. These are represented by wattles in old males of the recent hog. In the *E. ramosum* these tuberosities become processes, and the anterior ones especially are so long that when the chin was stretched, hog-like on the mud, it was raised well above the surface, allowing the passage underneath of water or of small animals. In the John

Day beds of Oregon another species of this genus is found, the *E. imperator* of Leidy, which was little inferior in dimensions to the *E. ramosum*. The greater part of its skeleton is known.

The pigs (SUIDÆ) are modified and specialized descendants of some form allied to Palæochœrus. Chronologically speaking they are of rather modern origin. The genera are as follows: —

(*a*) Molars and superior incisors not reduced; the former not covered with cement; superior canines recurved (Suinæ).

Molars with cusps united into transverse crests, *Listriodon* Meyer.

Molars with four much plicate tubercles on each..*Hippohyus* Cautl. Falc.

Molars with numerous irregular accessory lobes; premolars $\frac{4}{4}$ .... *Sus* Linn.

No accessory lobes; premolars $\frac{2}{2}$..................*Babirussa* Cuv.

(*aa*) Superior incisors reduced in number; molars reduced in number, and the valleys filled with cement (Phacochœrinæ).

Superior incisors one; premolars none; molars $\frac{2}{2}$, with numerous tubercles; superior canines recurved..............*Phacochœrus* Cuv.

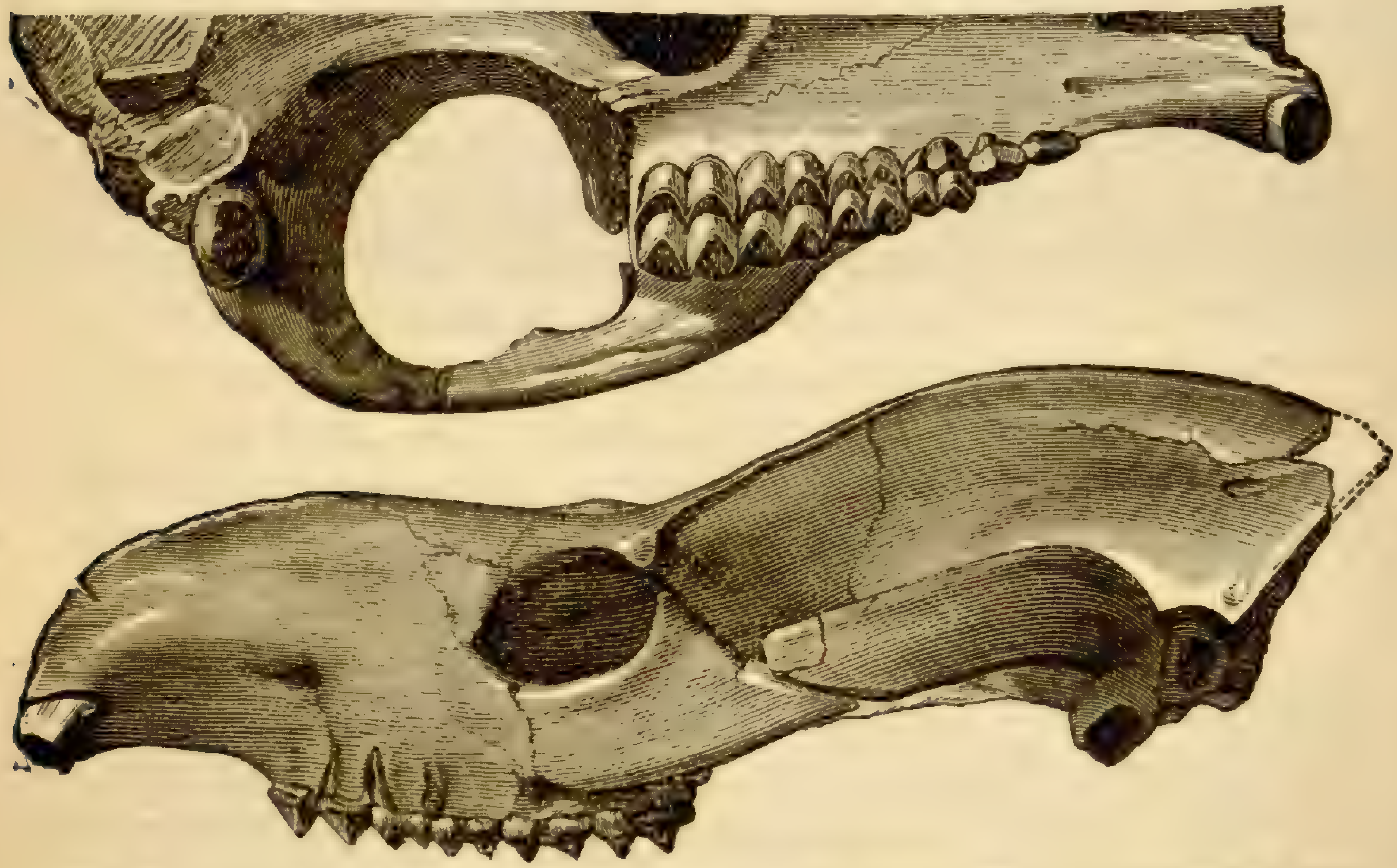
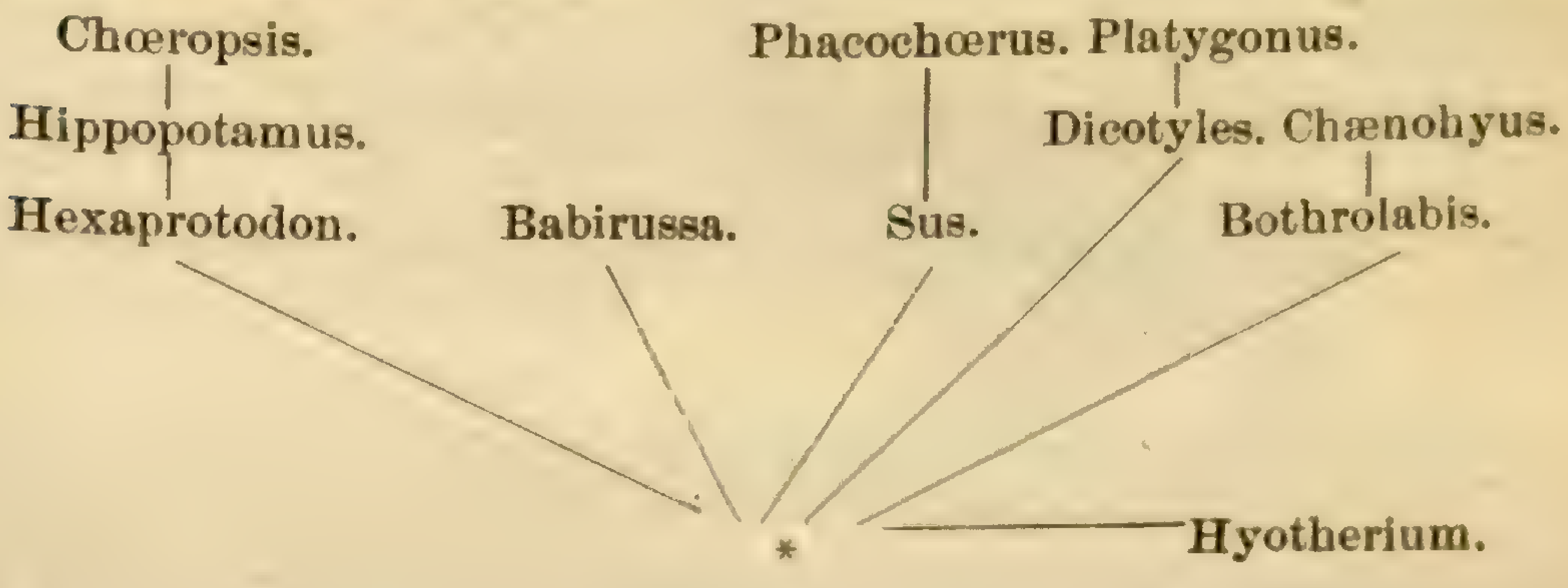


FIG. 5.—*Coloreodon ferox* Cope, skull from the John Day Miocene of Oregon, one-half natural size.

Listriodon and Hippohyus are the only genera of Suidæ which are extinct; but the extinct species of Sus are more numerous. In Listriodon the molar teeth are so tapir-like as to have led to its being placed in the Perissodactyla. When the skeleton was ob-

tained, it was found to be artiodactyle, as suspected by Kowalevsky. One species, *L. splendens,* has been found in the Middle Miocene of Western Europe. Hippohyus C. and F. is known from the Indian Siwaliks. A genus of probable affinities to it, founded on teeth only from Asiatic localities, is the Sanitherium of Schlagintweit. Some of the extinct species of Sus were of larger size than the existing hog, as the *S. giganteus* of the French Miocene, and the *S. erymanthius* of Pikermi, Greece. The *S. silvanius* Hodgson, a recent Indian species, is not larger than a small dog.

The phylogeny of these two bunodont families is nearly as follows, although the absence of intermediate types renders the final determination as yet impracticable. The main features may be however foreshadowed. The most generalized form is Palæochœrus, since its dentition is in all respects the most simple, while it preserves the full number of teeth. An unknown form resembling it, but with well-developed canine teeth, may have readily given origin to the Dicotyline line on the one side, and Sus and its immediate allies on the other. Babirussa is another derivative from the same centre. Phacochœrus may have come from some ally of Sus, since it carries to a great extreme the peculiarities of the latter genus. The ancestry of Hippopotamus is less easily determined. Its imperfect distal metapodial keels, which only exist on the posterior face of the condyle, bespeak for it an ancient ancestor. Its molar type is merely a complication of the quadritubercular, while the characters of its canines are an exaggeration of those of the primitive forms already mentioned. Several other genera, as Dicotyles and Sus, display the decumbent incisors which prepare the way for the remarkable straight digging incisors of Hippopotamus. The genus Hexaprotodon eases the passage backwards. These relations may be expressed as follows:—



The MERYCOPOTAMIDÆ embrace but one genus, Merycopotamus C. and F., which is a form of considerable interest. Its superior molars display the simple quadriselenodont type of the later families, but in the lower jaw the primitive condition of but one series of crescents still remains. Several species are known, all from the upper miocene of India.

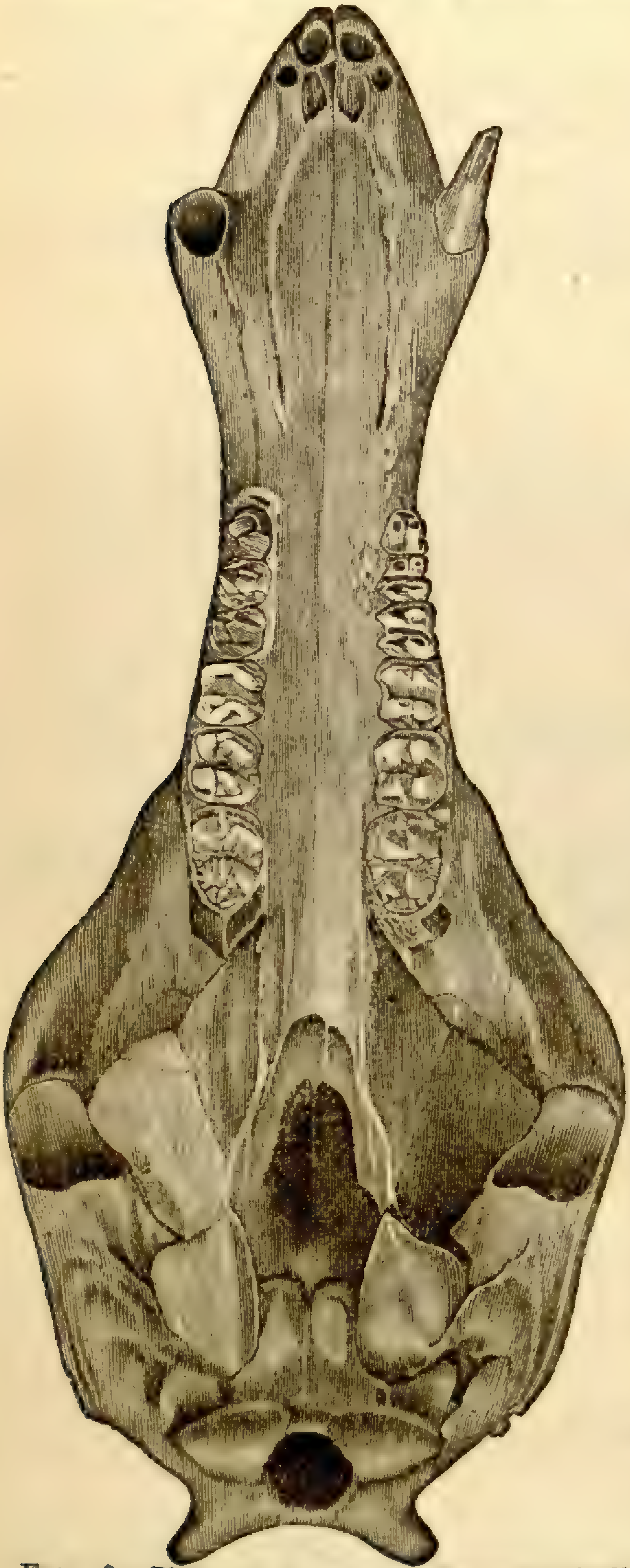


FIG. 6.—*Platygonus compressus* Leconte; skull from below, ⅜ nat. size. From Kentucky.

The OREODONTIDÆ is the prevalent type of Artiodactyla during Miocene time in North America. Their characters are as follows:—

Dentition: superior incisors present; molars selenodont. Cervicals with the transverse processes perforated by the vertebrarterial canal. No alisphenoid canal. Ulna and radius, and tibia and fibula distinct. Metapodial bones four on each foot, with incomplete distal trochlear keels. Lunar bone not supported by magnum Navicular and cuboid bones distinct.

The details of the structrue express various affinities. The axis is intermediate between that of the suilline and ruminant Artiodactyla; the other cervicals are suilline, while the remaining vertebræ are ruminant. The scapula is ruminant, not suilline; while the

humerus is like Anoplotherium. The radiocarpal articulation is intermediate between that of hogs and ruminants. The unciform supports the lunar bone. The sacrum is ruminant, the ilium suilline. The femur and tarsus are much like those of the peccary.

The known genera of this family are the following:—

A. Orbit complete; premolars four, the fourth with one external crescent. First premolar below functioning as canine.

a. No facial vacuities.

Premaxillaries distinct; otic bullæ not inflated; five digits in manus..*Oreodon* Leidy.

Premaxillaries distinct; otic bullæ inflated; four digits in manus..*Eucrotaphus* Leidy.

Premaxillaries coössified; otic bullæ inflated................. ....*Merycochœrus* Leidy.

aa. Facial vacuities present.

Premaxillaries coössified, dentigerous; vacuities prelachrymal only..*Merychyus* Leidy.

Incisors six above, persistent; vacuities prelachrymal and prefrontal; nasal bones much reduced.....*Leptauchenia* Leidy.

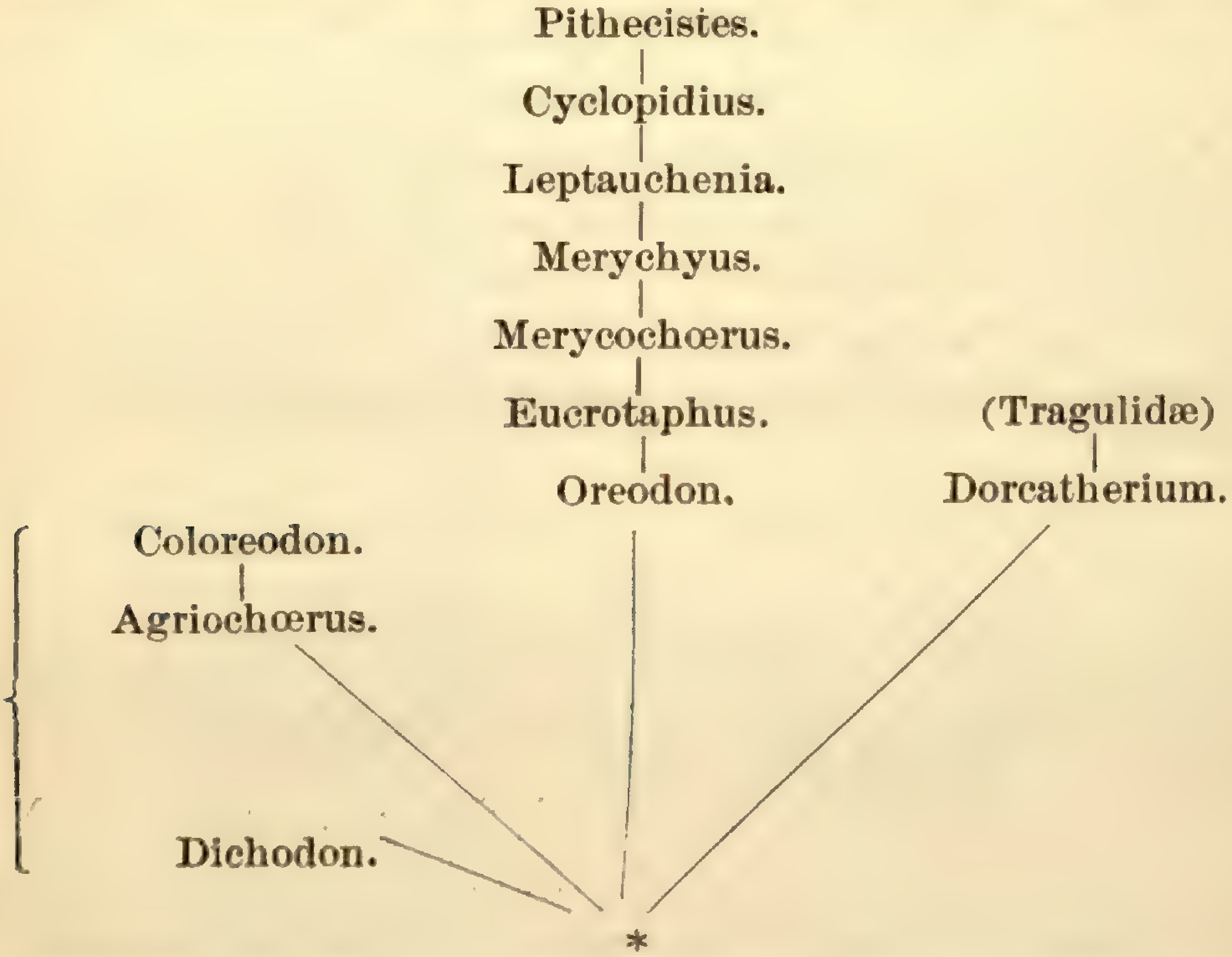
Incisors very few, caducous; vacuities as in Letanc phenia, very large..*Cyclopidius* Cope.

AA. Inferior premolars three. True inferior canine functional.

Inferior incisors one on each side...........*Pithecistes* Cope.

Starting from Oreodon as the ancestral form, Eucrotaphus follows at a little distance. The presence of the pollex observed by Scott in Oreodon proves that it must be referred to a five-toed common ancestor with Dorcatherium. The enlarged bullæ are added in Eucrotaphus, and the coössified premaxillaries in Merycochœrus and Merychyus. The latter commences the facial vacuities, which reach such huge proportions in Leptauchenia and Cyclopidius. The loss of the incisor teeth from both jaws, and diminished size, indicate that decadence is going on in Cyclopidius, but the last term is reached in Pithecistes. Here not only incisors but a premolar disappears. This family, once powerful in numbers, size and strength, disappeared with the Upper Miocene period in North America. These relations may be thus displayed. A common ancestor with Dorcatherium is assumed. This will be a genus like Protoreodon S. and O., but without the caniniform inferior p. m. i of

that genus, and probably with the fifth crescent of the superior molars. Agriochœrus may have been derived from the same.



The genealogical positions of these genera are as follows:

Oreodontinæ.	No. of Species	White River Epoch	John Day Epoch	Ticholeptus Epoch	Loup Fork Epoch
Oreodon Leidy	3	—			
Eucrotaphus Leidy	3	—	—		
Merycochœrus Leidy	8	—	—	—	—
Merychyus Leidy	6			—	—
Leptauchenia Leidy	3			—	
Cyclopidius Cope	2			—	
Pithecistes Cope	3			—	

The numbers of individuals of Oreodontidæ which must have existed during the Miocene period in North America is so great as to astonish the palæontologist. During the White River epoch droves of *Oreodon culbertsoni* inhabited the swamps, and the small *O. minor* was abundant. Several forms, perhaps species, coexisted with these two. During the John Day epoch Oregon and adjacent regions were overrun by the *Eucrotaphus pacificus*, and the large and formidable *Merycochoerus superbus* (Plate XXVI). At a still later date, in the Ticholeptus epoch, the species of Cyclopidius were scarcely less abundant. All of these forms were the prey of numerous Carnivora, mostly false sabre-tooth or half sabre-tooth cats,

of the family of the Nimravidæ. The large Merycochœri possessed the means of making a formidable defense, but the Merychyi of later age were of decidedly less vigorous mould (Plate XXVII). The species of Leptauchenia and Cyclopidius were probably aquatic in their habits. The species of the last named genus (Plate XXVIII.) had produced tympanic bones like the hippopotamus for the insertion of ears that projected above the water, while the eyes are partly vertical to permit of vision without much exposure of the head. The nostrils are at the extremity of a sharp muzzle like the snapping tortoise to premit of breathing without exposure of the face. The object of the remarkable facial vacuities in this genus and Leptauchenia is unknown. It may have permitted the attachment of an inflatable integument like the nasal hood of the hooded seal. In Pithecistes the incisor teeth have disappeared, and the short deep jaw, the only part which is known, resembles in its coössified symphysis, that of a monkey.

(To be continued.)

RECENT LITERATURE.

Davis's Text-book of Biology.[1]—Of this book of 462 pages a little more than one-third is devoted to plants, and hence properly to be noticed by the present reviewer. Unlike many works on biology, this is in fact two independent books printed and bound together. Each part has its separate bibliography and index-glossary, and there are no references from the one part to the other. One is puzzled, indeed, to see any good reason for calling the book one on biology: it is rather a botanical and a zoological book bound together.

Part I. takes up in succession Saccharomyces, Bacteria, Mucor and Penicillium as representing the fungi; Protococcus, Spirogyra, Fucus, Chara and Nitella, representing the Algæ; Funaria and Polytrichum for the Mosses; Pteris and Nephrodium (Aspidium) for the Ferns; Pinus for Gymnosperms, and a "typical Flowering plant" for the Angiosperms. Following these are short chapters on Comparative Vegetable Morphology and Physiology, and the Classification of Plants.

The book is not a laboratory manual at all, but rather a text-book to be read or studied. The author himself, in his preface, after referring to the several excellent works on practical biology which have appeared within the last few years, and the want of a comprehensive work on theoretical biology, says that "the object of the present text-book is, therefore, to supply such a systematic and simple exposition of the subject within small compass as, it is hoped, will be found helpful, both to those who are studying alone and to those who have the advantage of guidance in their work." Theoretical biology is, then, the scope of the work, and in this it stands in sharp contrast with Huxley and Martin's well-known laboratory handbook.

The treatment of Saccharomyces—the Yeast Plant—may illustrate the style of the book. First the Morphology is concisely discussed, giving the reader a good idea of the shape, size and structure of the plant, the latter including the cell-wall, protoplasm and vacuoles, with a doubtful reference to a nucleus. Secondly, the Physiology is taken up, and here nutrition is discussed in such

[1] *A Text-book of Biology:* comprising Vegetable and Animal Morphology and Physiology. Designed more especially to meet the requirements of the intermediate science and preliminary scientific examinations of the London University. By J. R. Ainsworth Davis, B.A., Trinity College, Cambridge; Lecturer on Biology in the University College of Wales, Aberystwyth. With numerous illustrations, "Glossary and Examination Questions." Philadelphia: P. Blakiston, Son & Co., 1012 Walnut street. 1888. [All rights reserved.]

a manner as to bring out the fact that the plant's food is a solution consisting essentially of carbon, hydrogen, oxygen, nitrogen, sulphur and phosphorus. Destructive metabolism, respiration, and reproduction follow, each including a brief summary of the principal facts.

In the main, the book appears to be brought up to our present knowledge, and, if one must use such a book at all, it may be recommended as giving in a condensed and systematic form the principal facts of Vegetable Morphology and Physiology. It remains to be said that, while the book bears the name of the American publisher on its title-page, both printing and binding were done by a London house, a new title-page alone having been pasted in to replace the original one.—*Charles E. Bessey.*

Microscopical Physiography of the Rock-making Minerals. By H. Rosenbusch. Translated by Joseph P. Iddings. New York: Wiley & Sons, 1888. Illustrated by 121 wood-cuts and 26 plates of photomicrographs. xiii. and 333 pp.—With the excellent translation of Prof. Rosenbusch's book, presented us by Mr. Iddings, there can no longer remain an excuse for the continued neglect of microscopical petrography by our colleges and advanced schools. Heretofore the immense mass of facts relating to the microscopical properties of minerals which have accumulated within the past ten or fifteen years, have been beyond the reach of those who are not familiar with the German language. The excellent compendium of Prof. Rosenbusch has not been available to English-speaking students on either side of the Atlantic. It is a matter for congratulation that the first translation of this book should have been made into English by an American Scientist, and by one who has proven himself so capable of undertaking the task as has Mr. Iddings.

The translation is at the same time an abridgement. The six hundred and sixty-four pages of the original have been reduced by the translator to three hundred and thirty-three. This has been accomplished by omitting the bibliography (which occupies eighty-eight pages in the original), by excluding the purely historical portions, and by restricting within narrow limits the discussion of the anomalous action of certain minerals in polarized light. Since these matters would be of little value to any but the advanced student in the subject, and since such a one must of necessity go to the original sources for his information, Mr. Iddings has done well in deciding not to confuse the mind of the beginner with too much of the unessential. So far as a hurried reading of the book allows one to judge, everything essential to the study of the optical properties of the rock-forming minerals has been retained, and in many cases additions have been made to the description of those minerals

which have been found to be much more widespread as constituents of rocks than was supposed when the German edition was published three years ago.

A further reduction in the size of the book is effected by a rather free translation, by which an entire sentence is sometimes reduced to the position of a short qualifying phrase, and by the omission of certain tables of refractive indices, but more especially by the exclusion of the references to the occurrences of the various minerals in rocks of foreign localities. To compensate for the latter loss, notes on American occurrences have been copiously inserted.

The style of the language used is clear; the expressions are forcible; and, better than all else, the reader of the translation may rest assured that he is getting the exact thought of the author of the original.

Not only is Mr. Iddings to be commended for his careful translation, but Messrs. Wiley & Sons are likewise to be congratulated on producing a work of such a pleasant appearance as the book before us.

The only fault that can be found with the volume is its price. It would seem that in view of the fact that the translation will meet with a ready sale in England and America, its price might have been placed at such a figure as to enable every one taking a course in geology to indulge in the luxury of a few weeks' work with the beautiful objects in rocks revealed to our eyes when aided by the polarizing microscope.—*W. S. B.*

GENERAL NOTES.

GEOGRAPHY AND TRAVEL.

Nansen's Greenland Expedition.—The last mail from Norway brings more information about the Nansen expedition to the interior of Greenland. The expedition consisted of the following named daring men, under the leadership of Dr. Frithjof Nansen, conservator of the Bergen Museum; Lieut. Olaf Dietrichsen, Mate Otto Sverdrup, Christian C. Trana, Ole N. Ravna, and Samuel J. Batto, all especially selected men, strong and healthy in body and mind and good "ski-runners." "Ski" are the snow shoes extensively used in Norway for travelling over the snow fields of that country. The party left Norway on May 2; travelled by steamer as far as to Iceland, where they arrived in the middle of June. From Iceland the whaler Jason brought them over to Greenland, and on the

17th of July left them on the drifting ice with the land in sight some few miles distant. From that time until they could reach the inhabited west coast of Greenland communication with the rest of the living world would be an absolute impossibility. A stretch of 450 miles, never traversed by man, lay before them; they had their Norwegian ski, provisions for two months, and necessary instruments for making observations, and they started for the shore. They had to make their way across the glaciers in two months or die. Not before next summer can we have a complete report of the journey; till then we must, with the information we get from two hurriedly written letters which, by mere accident, came over in the last vessel from that region this year. The letter from the mate Sverdrup to his father is given below:

GODTHAAB, *Oct. 4, 1888.*

"Yesterday, after sixty-four days' journey from the east coast, we arrived here all safe. The landing was more difficult than we had calculated. The drifting ice upon which we stepped when leaving the whaler was moving very rapidly toward the south and off from the shore, and it took us twelve days to reach the shore. In that time we had drifted nearly 100 miles. As soon as we had terra firma under foot we started northward along the coast, looking for a place where it would be possible to ascend the solid inland ice. After another twelve days' search we finally found such a place, made our way up without very great difficulty, and on the 16th of August we commenced our westward march. We at first laid our course for Christianshaab (a settlement to the northwest), but when we had reached an elevation of about 7500 feet a terrible snow storm met us, and we concluded to take a more southerly direction toward the Godthaab settlement, as this line would be shorter, and probably would not expose us so severely to the storms from the north. We had, indeed, a hard journey. The terrain in general and the snow were very difficult to walk upon, and the weather was rough. In about three weeks we travelled on an elevation of 10,000 feet in a temperature of 35 to 40° below zero; but we kept moving. Only four days were we held by storms. When we came across and down from the inland ice on the west side we found a stretch of about twenty miles wide free from snow, fifteen miles of which was along the edge of a fiord. We brought the tent and provisions down to the shore and built a camp; further proceeding seemed for a time impossible. Then we made a small boat from part of the tent and a canvas bag. When this boat was ready Dr. Nansen and I started for this place, and after four days' rowing we arrived here, and were very kindly received by the people. Two boats are now sent to the camp, where we left our companions, to bring them down here. The post-ship has left long ago, but some fifty miles farther south there is a steamer, having been acci-

dentally kept back by a breakdown and the storms, now just ready to sail for Copenhagen, and we send two messengers, hoping they will reach the steamer, and perhaps make it wait for us and take us home. We have but very little hope, though, that the steamer will wait, and we shall be compelled to stay here over winter, as this is the last chance this year."

It appears that the steamer did not wait for them, but took the letters and delivered them at Farsund, the nearest port in Norway. The expedition, consequently, must stay in Greenland through the winter, with the prospect of getting plenty of leisure time, and next summer we shall have a full report of this remarkably daring and interesting journey.

GEOLOGY AND PALÆONTOLOGY.

Description of New and Imperfectly Known Species of Brachiopoda, from the Devonian Rocks of Iowa.—Of the Brachiopod Fauna of the Devonian rocks of Iowa, no genus is, perhaps, so variable as the Genus *Atrypa*. Many varieties of *Atrypa recticularis*, of the Iowa strata, are often restricted in their range to certain horizons and localities. For example, at Iowa City, Turkey Creek and Roberts' Ferry, in Johnson county, there occurs in a bed of argillaceous shale a very large and coarse variety of this species, which is not known to appear at any other locality in Iowa, or elsewhere. In some dark bituminous shale at Independence, occurs another variety of the same species, and which is analogous to one of the varieties of the Rockford shales; this form, however, differs from the Rockford shale variety in its very diminutive size.

In the limestone at "Big Bend" of the Iowa river in Johnson county, at Independence, Waverly, etc., occurs another well-marked variety. Many individuals of this variety possess very large thin wings or expansions, the entire shell having a diameter of from five to eleven centimeters; the body of the shell, however, being often only one-half or even one-third that diameter.

At Littleton, in Buchanan county, is found another very distinct variety (a coarse form) whose equivalent is not known to occur at any other locality in the State; its nearest representative, so far as known to me, occurring in the Devonian strata at Louisville, Ky. In the Rockford shales occur two varieties, the smaller of which has the front of the shell so strongly contracted as to produce a dis-

tinct false mesial sinus in the ventral valve. Several other varieties of this species also occur in different portions of the State.

Not only do the Iowa varieties of this species vary greatly in form, size and surface markings, but they also often differ conspicuously in their internal structure. Some forms of this species approach so near to *Atrypa impressa* of the Schoharie Grit of New York, that a strict distinction between them is impossible. *Atrypa reticularis* of the Iowa strata varies so much in form, size, surface marking, etc., that it could be separated into several forms sufficiently distinct to have specific names, if the forms were found only distinct groups of rocks. *Atrypa hystrix* and *Atrypa aspera* also vary greatly in form, size and internal structure. An interesting feature of the Brachiopod and Polyp faunas of the Devonian strata of Iowa, is the occurrence of quite a number of forms which imperceptably grade into one another; but which forms are seen, in the rocks of other States, to constitute well-marked species. This condition is more particularly noticeable among some forms of the genera *Favosites*, *Cyathophyllum*, *Atrypa* and a few others.

Spirifera substrigosa, n. sp.—Shell a little larger than medium, somewhat longer than wide, slightly gibbous; cardinal extremities abruptly produced into short rounded projections. Dorsal valve moderately convex; greatest convexity slightly above the centre. Mesial fold angular, strongly produced in front; marked by five small scarcely elevated rounded plications, only one of which reaches the beak. Valve, on each side of the mesial fold, marked by five strong, broadly rounded radiating plications; cardinal extremities smooth. Ventral valve rather gibbous; greatest convexity about the centre; mesial sinus rounded, of moderate depth, quite rapidly expanding below, and produced into a moderately broad rounded extension; beak much elevated, sharp and strongly incurved; foramen rather large, triangular; area moderately large, concave.

Surface of the ventral valve, on each side of the mesial sinus, marked by six or seven strong, rounded, radiating plications; a small area on the cardinal extremities smooth. Mesial sinus ornamented by four small slightly elevated plications, the two outer ones becoming obsolete a little above the centre of the valve, and the two central ones uniting about the centre of the valve and extending to the beak as one. The front fourth of each valve marked by strong undulating lines of growth; the rest of the surface smooth. This species is more closely allied to *Spirifera strigosa* than to any other described species known to me. Position and locality: Rockford Shales, Hackberry, Iowa.

Spirifera hungerfordi Hall. (Compare with original description, Geology of Iowa, Vol. I, Part 2, p. 501.)—Shell very variable, adult forms often being three and one-fifth centimeters in width,

and about three and one-half centimeters in height; inequivalve hinge line sometimes (in both young and old specimens) extremely produced into wing-like expansions; at other times the hinge line equalling, or much less than the greatest width of the valves below; again, some specimens (old and young) are longer than wide; at other times wider than long, even though the hinge line is not produced.

Dorsal valve generally regularly convex, but sometimes flattened on the cardinal extremity; greatest convexity at or a little above the middle; beak incurved slightly beyond the hinge line; mesial fold often not defined; at other times slightly defined; and rarely strongly and sharply defined in front.

Ventral valve gibbous at or above the middle, having twice as great an elevation as the opposite valve; beak generally much extended above the hinge line, but sometimes scarcely; sharply incurved, or not incurved; sinus sometimes wanting, at other times shallow and scarcely defined above the middle, and producing a slight sinuosity (at times strongly produced) in front; in some specimens with greatly produced hinge lines, the sinus is quite well defined nearly or quite to the beak; area large and well defined, principally confined to the ventral valve, vertically striated; foramen narrow, triangular, extending quite to the open valve, the margins or dental lamellæ often a little projecting. Surface marked by fine rounded radii; radii about equal to the space between them, "and both are again finely striated in the same direction by microscopic lines, and the whole crossed by fine striæ which give a granulated appearance to the uneven surface"; this feature, however, is not always well shown even in well-preserved specimens.

The "dichotomising of the radii on the mesial sinus and fold" is by no means a constant feature. The internal structure of this shell varies considerably in different individuals. The dental lamella, which is usually very strong, generally extends to the centre of the valve, and there becomes obsolete; these lamellæ gradually diverge downward and about the centre of the valve, between them, is a deep heart-shaped muscular impression, marked by four to six more or less prominent vertical striæ; the dental lamellæ sometimes extend to the centre of the shell only as slight elevations along the margins of the muscular impressions; the muscular impressions vary somewhat in size, depth and general form in different specimens.

In some instances, the interior of the ventral valve is distinctly punctate; cardinal processes of dorsal valve rather large, bifid, and fitting into notches in area of ventral valve. Internal spires rather large. Position and locality: Throughout the Rockford Shales, Iowa.

Spirifera strigosa Meek. *Spirifera macra* Meek (1860), Pro-

ceed. Acad. Nat. Sci., Phila., XII, 309. *Spirifera strigosa* Meek (1860), to extra copies of the above cited paper. *Spirifera orestes* Hall and Whitfield (1873), 23d Rept. Board of Regents on N. Y. State cabinet, P. 237, *Spirifera strigosa* Meek (1876), in Col. Simpson's Report Expl. across the Great Basin of Utah, 347, pl. I, figs. 5,a,b,c,d. Compare with description of *Spirifera orestes*, of H. and W., 23d Report of Board of Regents on New York State cabinet of Nat. His., p.237; and also with description of *Spirifera strigosua* Meek, U. S. Geol. Exploration of Fortieth Parallel, Vol. IV., p. 43.

Shell very variable; semielliptical, subouate, suborbicular, longer than wide or wider again than long; of medium or under medium size; often gibbous in young as well as old specimens; frequently greatly extended on the hinge line, sometimes hinge-line one-third less than the greatest width of the valves below; at other times the hinge-line and valves below are equal, valves subequal; greatest convexity of the ventral valve at or slightly above the middle; greatest convexity of the dorsal valve at the centre, or a little above. Beak of ventral valve strong and usually high, sometimes low; from slightly to very sharply incurved; the height, strength and curvature of the beak varies somewhat with the age of the animal; central area high, concave, vertically striated; foramen rather large, triangular, extending to the apex of the valve, the margins or dental lamellae strongly projecting in well-preserved specimens.

Valves marked by very large or small, simple, rounded or angular plications; varying in number from four to thirteen on each side of the mesial fold and sinus, in young as well as adult forms.

Mesial fold and sinus marked by from one to six bifurcating plications (in some instances, the plications do not bifurcate, but run out along the margins of the fold and sinus). Usually the mesial fold is strongly elevated in front and more or less well defined to the beak, but in rare instances, even in adult specimens, the fold is not defined, even in front, although the sinus of the opposite valve is well defined to the beak, and produced in front.

Mesial sinus more or less well defined to the beak, rather rapidly expanding below, and produced in front into a sharp or broadly rounded extension; bottom shallow or deep, angular or rounded. Surface of specimens, with small or medium-sized plications, marked by very fine striæ parallel to the plications; surface of specimens with large, coarse plications, marked by stronger and more numerous oblique striæ, which unite with each other on the summit of the plications and centre of the depressions between the plications, thus giving the entire surface a very sharply zigzag striation; the surface of many specimens are also crossed, in front, by slight lines of growth.

Surface of the interior of the valves smooth or marked by ridges, which correspond to the depressions between the plications on the

exterior of the valves; dental lamellæ in ventral valve slightly produced, sloping abruptly backward and downward, becoming obsolete before reaching the center of the valve; cardinal processes of dorsal valve small, bifid, fitting into notches in area of ventral valve.

This is one of the most variable species of Spirifers known to me. The descriptions of this species, and *Spirifera hungerfordi*, are based upon over one hundred and fifty specimens of each species.—Position and locality: Rockford Shales, Rockford and Hackberry, and Owens Grove, Iowa.

There seems to be no doubt but that this very variable species (designated as *Spirifera orestes*, by H. & W.,) is identical with *Spirifera strigosa* Meek, as described in Vol. IV., p. 43, of the U. S. Geol. Exploration of Fortieth Parallel. This being the case, Meek's name would, therefore, be considered as having the priority.

Atrypa hystrix var. *elongata*, n. var.—Shell of medium size, elongate ovate, valves slightly aud nearly equally convex; greatest convexity of the ventral valve slightly below the umbo; greatest convexity of the dorsal valve on the umob. Beak of the ventral valve of moderate strength, perforate, scarcely raised above the opposite valve; area closed, surfaces marked by from four to five simple rounded ridges upon each valve, crossed by strong thickened concentric laminæ of growth, but which are not elevated at intervals into spine-like protections. This well-marked variety is known to occur at only one locality, the Rockford Shales, at Hackberry, Iowa.

Atrypa hystrix var. *planosulcata*, n. var.—This form differs from *A. hystrix* in the general expression and fineness of the shell. The plications are very much smaller and more numerous, the laminæ of growth usually slight and not generally elevated into spine-like projections. These features are very constant in both young and old specimens.

We were at first inclined to consider this form specifically distinct from *A hystrix*, but after a large number of them had been secured, it proved that they constituted only a well-marked variety of this species.

This variety is common throughout the Rockford Shales, and is also the prevailing form which occurs in the limestone which immediately underlies the shales. We have also secured a very few specimens from some shales at Roberts' Ferry, Solon and Turkey Creek, in Johnson county.—*Clement L. Webster.*

Caves and Cave Life.—There are a few statements made in Dr. Packard's article in the September number of the American Naturalist, which, while they do not affect the argument, seem to need

correction. First, on pp. 814–815, occurs the statement: "It is probable that *Cæcidotea stygia* is seldom, if ever, brought in contact with *Asellus communis*, which abounds in the pools and streams throughout the cave region." For this I can see no reason. As I have lived for some time in the cave region, I may say that Cæcidotæa is not confined to "caves and wells fed by underground streams," but occurs in Bloomington in springs and in the ordinary streams, mingling with its near relative Asellus. Again, except for the single element of darkness, I cannot see how the cave fauna, occurring in the numerous caves around this town, and extending south to Wyandotte and Mammoth, "is almost completely isolated from that of the upper world." Too many of the streams in this carboniferous belt drop out of sight, and can be traced directly into caves about here to afford much isolation to aquatic animals.

Not having seen the complete article from which his paper "On Certain Factors of Evolution" is an extract, I do not know on what Dr. Packard bases his conclusion (p. 815) that the cave faunæ are to be regarded as products of Quaternary times. Of course the general facies of that fauna is recent, but it is, on the other hand, beyond question that the caves themselves have been in process of formation since their rocks were elevated above the carboniferous sea. I know of no argument which forbids the idea of their being peopled in Permian times. The fact that we have no cave fossils giving evidence of a Mesozoic fauna is easily explained by the fact that there was no locality for such fossils to form. Caves are constantly being enlarged by a solution of their walls, and with the wearing away of the rock all cave-animal remains would of necessity be destroyed.

While on this subject of caves I may call attention to a few facts which I have observed during the past year in regard to their formation, and I do so the more willingly since I find a belief quite prevalent that they were caused by the "Champlain floods." Southwestern Indiana and Central Kentucky and Tennessee are, *par excellence*, the cave region of America. A few caves have acquired more than local prominence, yet from Bloomington south, one cannot go a dozen miles without striking several caves. Now all this region is below the line of the drift; nowhere in it can one find a single morainic boulder. It is rather a region of topographic old age. The "Knobs" which skirt the Ohio, from Louisville to Evansville, are produced solely by atmospheric agencies, and the same physical features characterize the whole region. In the valleys, to be sure, occur the channels which must have borne off the floods caused by the melting ice of the Continental glaciers, but the river-courses of to-day but occasionally coincide with those which must be invoked to explain the presence of the caves. To explain the existence of the caverns we must predicate streams whose

beds have now entirely disappeared, except as they are shown inside the caves. For instance, the Blue river of to-day cannot be connected with Wyandotte Cave. The entrance to the cave occurs on a side hill, a hundred feet above the present stream, yet inside the cave there is ample evidence, not only of the long-continued action of small amounts of water, but, in places, the plainest signs of a considerable stream. So, too, in Little Wyandotte, a few rods away. Still, where that water entered the cave, and where it made its exit, are as yet unsolved problems. In the majority of caves which I have seen, the entrance seems a secondary formation produced by a falling in of the roof, or a wearing away of the hill itself. This last is clearly the case with Wyandotte Cave, which apparently once had a greater extent than it now has. In other cases the entrance is through a "sink-hole," but it requires no little credulity to believe that that little funnel conducted the water which wore away such a cavern as "Coon's Cave" in this county (Monroe).

Some facts which I have observed, but which I have not seen recorded, seem to show that this cave region formerly contained more caves than now, but that they have disappeared by wearing away of the rock in which they were contained. On the slope of the hill, near the path which leads from the Wyandotte Cave Hotel down to the well at the fort, where the blind fish are found, are apparently the remains of a cave, the walls and roof of which have utterly disappeared, the only traces which remain being the stalagmites on the floor. So, too, on Blue river, about half way from Wyandotte to the Ohio, occur what are known as Castle Rocks, and these turrets, rising several feet above the surrounding country, seem to be the last vestiges of a former cave of considerable dimensions, the other walls of which have been carried away.

These facts, which I have thus jotted down, all go to show that in the Indiana-Kentucky-Tennessee cave region, time has been no inconsiderable element in the process of cavern formation, and I believe that the majority of the caves about here had acquired essentially their present sizes and dimensions long before the appearance of the "great glacier" so often invoked to explain all sorts of phenomena in dynamical geology. That it is not at all adequate to account for the caves is evident to any one who visits this region. Recourse must be had to a time when the whole physical geography was different, and when southwestern Indiana was not cut up into its present condition of steep hills and cañon-like water courses.—*J. S. Kingsley, Bloomington, Ind.*

Goniopholis in the Jurassic of Colorado.—In my essay on the horizons of vertebrate fossils of Europe and North America,

read before the International Congress of Geologists of 1878,[1] I recorded the probable occurrence of this Jurassic genus of Crocodilia in North America. This supposition has become a certainty, as a result of a more detailed examination of material received from Mr. O. W. Lucas, of Canyon City, Colorado. This consists of a nearly entire skull, with numerous portions of the skeleton, derived from the locality which furnished the typical specimens of *Camarasaurus supremus* Cope, and other Reptilia. It appears that the specimen is specifically identical with one which includes vertebræ and a few other bones only, described by me as *Amphicotytus lucasii*,[2] from the same locality. The species may be therefore called *Goniopholis lucasii.*

The superior surfaces of the skull and dormal scuta are rather finely and profoundly pitted. The orbits are a little smaller than the crotaphite foramina, and each one has a strong supraorbital bone, which is also pitted. The muzzle is of moderate length, and is proportioned much as in the Nile crocodile. Its extremity is neither abruptly expanded nor recurved. The anterior teeth are sculptured with coarse, shallow, parallel grooves. Those of the posterior portion of the maxillary bone have opposite angles at the extremities of a transverse axis extending inwards and forwards and outwards and backwards, but the crown is not compressed at the base, though slightly so at the apex. The posterior nares are narrow, and are divided by a median septum. Their anterior border is opposite the middle of the palatomaxillary foramen. The pterygoids terminate posteriorly in a wide, free, transverse margin.

The *Goniopholis lucasii* was equal to a two-thirds grown Mississippi Alligator in dimensions, and its head was of relatively larger size. It was smaller than the *G. crassidensowrn.*

Measurements.

Length of cranium on median line	.385
Length from end of muzzle to line of orbits	.245
Length from end of muzzle to line of crotaphite foramina	.310
Width of cranium between quadrates inclusive	.250
" " table of cranium	.110
" " parietal space	.015
" " interorbital space	.040
" " muzzle at front of orbits	.110
" " muzzle at nares	.090
Length of fore part of pseudocanine tooth	.035
Width of fore part at base of crown	.013

E. D. Cope.

American Fossil Cryptogamia.—At a meeting of the Biological Society of Washington on Nov. 17th, Prof. L. F. Ward read a paper,

[1] Comptes Rendus Stenographiques, Paris, p. 146; Vertebrata Tertiary of the United States, 1885, p. 26.

[2] Bulletin U. S. Geolog. Survey Trans. F. V. Hayden, 1878, p. 391.

on "A comprehensive type of fossil cryptogamic life from the Fort Union group," illustrating it by lantern views. The fossil in question was so peculiar that though collected in 1883, he had done little with it until the present season. Photographs of it were sent to various eminent zoologists and botanists, with a view of determining the affinities of the curious specimen. Zoologists could not refer it to any animal, and so considered it a plant; while botanists, knowing no plant like it, thought it possibly an animal. Prof. Ward's conclusion so far is that it represents a generalized type of vascular cryptogam, with relationships to Ophioglossum, Isoetes, Marsilea, Lycopodium and Selaginella. It is evidently an aquatic, fresh water, as shown by the remains of aquatics in the same connection. A central, roundish rhizoma or rhizoid, is surrounded by slender, flexuous bodies, radiating in all directions, each expanding from a rather narrow base to a broad club-like end. The scales are arranged in two or three rows; at the base are found numerous round bodies like spore cases, and the free end has a flattened blade about twice as wide as the main stem and rounded. In the general aspect of the rhizoma it is related to Isoetes. In its branches and fructification to Ophioglossum and Marsilea, and in its scales to Lycopodium and Selaginella. Letters from Prof. Farlow, Dr. Nathorst and Count Saporta, were read, and these scientists suggested a possible connection with the same forms of cryptogams as Prof. Ward had himself imagined. In a discussion which ensued, Prof. Seaman called attention to the similarity the specimens presented to the structure of the hairs of *Drosera rotundifolia.* It would indeed be strange if in this fossil plant of Cretaceous times we should have foreshadowed and produced on a large scale the hairs of Drosera, each acting independently instead of working in common. It must be said, however, that the chances are greatly in favor of the view of Prof. Ward, that it is a generalized form of certain groups of the vascular cryptogams.—*Jos. F. James.*

A Horned Dinosaurian Reptile.—In the December number of the *American Journal of Science and Arts,* Prof. O. C. Marsh describes parts of the skeleton of a Dinosaur from the Laramie formation of Montana, including parts of the skull. The latter is remarkable in supporting on its posterior part a robust horn-core on each side, somewhat like that of the ruminating mammals. Prof. Marsh concludes that the genus to which this animal belongs is allied to Hypsirhophus (Stegossaurus) of the Jurassic. This interesting discovery of Prof. Marsh will solve a problem which has remained unsettled for over ten years. In 1877, in the *Bulletin of the U. S. Geological Survey* of the Territories, Vol. III., p. 588, the present writer described parts of the skull of this animal and figured some

of them, including a horn-core and posterior part of the skull (Plate XXXII., fig. 8). These fragments were also found in the Laramie bed of Montana, probably at no great distance from those described by Prof. Marsh. I did not determine the genus to which this cranium should be referred, since there were already known nine genera of Dinosauria from the same horizon to one or the other of which, it was sure to belong. The observations of Prof. Marsh will determine this point. The affinity to Hypsirhophus referred to by Prof. Marsh indicates Polyonax (Cope) as the form to which the species probably belongs, although this is of course a mere surmise. That genus was described from vertebræ and limb and dermal bones (Cretaceous Vertebrata U. S. Geol. Survey Terri., II., p. 63, Plates II. and III.). Some of the latter were probably identified with doubt as parts of the shafts of limb bones, but they resemble more nearly some of the spinous dermal bones ascribed to Hypsirhophus by Marsh.

It would have been well if the final publications of the Hayden Survey could have been completed by the Director who succeeded him in charge, instead of new publications taken up. In that case the continued duplication of the work of the first survey by its successor could have been avoided.—*E. D. Cope.*

MINERALOGY AND PETROGRAPHY.[1]

Petrographical News.—Löwinson-Lessing[2] has suggested a scheme for the classification of elastic rocks. He would divide these into tuffs, breccias, conglomerates, pseudoschists and slaty rocks. Tuffs he would confine to rocks made up of crystals, or pieces of crystals, and separate minerals, and would subdivide into agglomerates-tuffs (subaëreal) and tuffogenous sediments (submarine). The agglomeratic tuffs he would further separate according to structure. Tuff-like rocks produced from crystalline rocks by orodynamic forces, or by weathering, he would call tuffoids, and distinguish as elasto-tuffs and decomposition-tuffs (Verwitterungs tuffen). The breccias are composed of pieces of rocks cemented by rock material. They are divided into primary, or volcanic, and secondary, or metasomatic breccias. The volcanic breccias include the lava agglomerates (Reibung's breccias), composed of pieces of foreign rock, or of the crust of a lava stream, which have been cemented together by a molten rock, and tuff-lavas (Spaltung's breccia),

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.
[2] Miner. u. Petrog. Mitth., ix., p. 528.

those produced by the separating from a molten magma of certain portions, and their consolidation into a rock mass by the cooling of the remaining portion. Both of these classes are again subdivided according to structure. The conglomerates include the conglomerates proper, psammite (a micro-conglomerate) and sandstone (when the microscopical grains are those of single minerals). The pseudoschists are metamorphosed sediments, breccias, or tuffs in which the line between the fragments and the cement has partially disappeared. The slates have the same signification as at present. —The basalt forming two hills near the village of Grossdehsaer, west of Löbau, in Saxony, contains numerous inclusions of granite which possess features of great interest. The basalt is composed of a mesh of augite crystals and a little glass, in which porphyritic augites, olivine, magnetite and a little plagioclase are imbedded. It contains also little veins of a colorless substance, with the chemical properties of nepheline. The basalt in breaking through the underlying granite brought pieces of the rock with it to the surface. The changes which have been produced in these included fragments and the effect which they in turn have produced in the basalt, are the occasion of a recent paper by Beyer.[1] The inclusions are divided into the porphyritic and glassy varieties. The basalt first disintegrated the granite, and then separated the broken fragments into their constituent minerals. These were then partially dissolved —the mica disappeared entirely and magnetite and spinel were developed; in the vicinity of feldspar new feldspathic material crystallized; the quartz was corroded and around its edges a light colored augite was formed. In the porphyritic inclusions remains of quartz and feldspar are still to be found; in the glassy ones all traces of the original minerals have disappeared, the composition of the glass alone remaining as proof of the granitic character of the inclusion. The effect of the inclusions upon the basalt is seen in the disappearance of the olivine, and the development in its stead of a brown glass surrounded by augite crystals. In the more acid portions feldspar has separated and has included many microlites of augite within itself. While these changes were going on in the granite and basalt, steam escaped from the mass of rock and produced a slaggy condition in the glass inclusions, and new minerals which are implanted in the walls of the cavities. In one case little colorless hexagonal crystals have the composition:—

SiO_2	Al_2O_3	CaO	MgO	K_2O	Na_2O	H_2O
57.50	18.11	4.63	1.20	6.98	2.40	10.48.

—The islands off the coast of Morbihan, France, contain strata of

[1] Miner. u. Petrog. Mitth., x., p. 1.

schistose pyroxene rocks, interbedded with archæan gneisses and mica-schists. They consist of sphene, garnet, green pyroxene, plagioclase, quartz, mica and pale hornblende in large crystals. Vesuvianite and zircon also occur in them in small quantity. The pyroxene, comprising the larger part of the rock, is of a light green color, and possesses the diallagic parting. The plagioclase—labradorite and anorrhite—is present in large quantity in some varieties of the rock, and always shows a tendency to alter into wollastonite. The hornblende and quartz are both secondary. These pyroxenites resemble very closely the flaser-gabbros of the Germans, but are supposed by Barrois[1] to be metamorposed limestones. He describes a limestone in contact with granite in the same region, in which the minerals characteristic of the pyroxenites have been developed.—Chrustschoff[2] includes under the name perthitophyre a series of dyke rocks occurring in the Department Volhynia, Russia, whose characteristics differ from those of any rocks heretofore described. They consist of an interstitial micropesthitic substance, in which various amounts of idiomorphic quartz, labradorite, monoclinic and orthorhombic augite, olivine, and other minerals are imbedded. In the coarser varieties the iron-bearing minerals are not abundant, while in the finer grained kinds they are in as large quantity as the feldspar. In the course of his article the author describes parallel growths of diallage and acicular crystals of an orthorhombic pyroxene, and also an apparently triclinic pyroxene. He also mentions the existence of anatase as an inclusion in the feldspar and quartz, and gives in brief the properties of a mineral whose nature he is unable to determine.—Sandberger[3] describes inclusions of hypersthenite, olivine-gabbro, and a rock composed of olivine, arfvedsonite, picotite, eustatite, sanidine and augite, from the phenolite of Heldburg, in the Thüringer Wald.—Posepuy[5] gives brief descriptions of a few sections of adniole in the course of an article discussing the structure of the well-known mining region in the vicinity of Przibram, Bohemia.

American Minerals.—A series of analyses[4] of *beryl* from Norway, Maine and Willemantic and Litchfield counties, Ct., seems to show that beryllium and the alkalies mutually replace each other in this mineral, and that water is a constant constituent. An analysis of *phenacite* from Florissant, Col., gave practically no alkalies. The barium feldspar (*cassinite*) from Bene Hill, Delaware county, Pa., first analyzed by Genth,[5] has been re-examined by

[1] Barrois: Ann. d. l. Soc. Geol. du Nord., xv., p. 69.
[2] Miner. und Petrog. Mitth., ix., p. 470.
[3] Neues Jahrb. f. Min., etc., 1888, ii., p. 24.
[4] Miner. u. Petrog. Mitth., x., p. 175.
[5] Report Min. Penn., 1866, p. 224.

Penfield and Sperry,[1] and found to have the composition:—

SiO_2	Al_2O_3	Fe_2O_3	CaO	Na_2O	BaO	K_2O	Ign.
62.95	19.82	.17	.25	4.01	3.95	8.57	.11

a result agreeing very closely with that of Genth. The authors regard the substance as a mixture of 35.23 per cent. albite, 51.15 of orthoclase, and 13.17 of hyalophane. The microscopical examination of its thin sections reveals the presence of albite lamellæ ntergrown with orthoclase, but does not show the hyalophane. analyses of *monazite* from Alexander county, N. C., of sussexite from Franklin, N. J., and of a very pure phlogopite from Edwards, St. Lawrence county, N. Y., are given in the same article.—Wülping[2] has used the results obtained by Riggs[3] in his careful analyses of tourmaline, to determine a general formula for the composition of this complex mineral. By reducing the amounts of the various substances found by Riggs to their equivalents in SiO_2, B_2O_3, Al_2O_3, MgO, Na_2O and H_2O, Wülping[5] concludes that the mineral may be represented as a compound of the molecules 12 SiO_2, 3 B_2O_3, 8 Al_2O_3, 2 Na_2O, 4 H_2O, and 12 SiO_2, 3 B_2O_3, 5 Al_2O_3, 12 MgO, 3 H_2O, in various proportions.—Crystals of *phenacite* from Mt. Antero, Col., present two habits. Those found in quartz or beryl consist essentially of rhombohedra of the third order, combined with prisms of the second order, while those attached to orthoclase show in addition a prism of the first order. The rhombohedral faces are dull, and the prismatic faces are vertically striated. Twin crystals of quartz with P_2 as the twinning plane are also described. —A remarkable variety of *oligoclase* from near Bakersville, N. C., is described by Kunz[6] as perfectly transparent. It has a faint green tinge, and contains cavities surrounded by tufts of white acicular microlites, like the glass that often solidifies in the bottoms of glass pots. It has the usual perfect cleavage of oligoclase, but is not striated. According to Messrs. Penfield and Sperry,[7] the optical properties of the mineral are abnormal. Sections parallel to oP show a positive extinction of 39°–40°. Those parallel to $\infty P' \infty$ remain dark during an entire revolution between crossed nicols, but in converged light yield an optical axis in the centre of the field instead of a bisectrix. The same writer calls attention to *quartz* pseudomorphs after spodumene from Peru, Me.; pseudomorphs of *iron oxides* after aragonite from Puma Co., Ariz., and beautiful transparent *cyanite* from Bakersville, N. C.—Crosby and Greeley

[1] Amer. Jour. Sci., xxxvi., p. 317.
[2] Miner. u. Petrog. Mitth., x., p. 161.
[3] Amer. Naturalist, 1888, p. 250.
[4] Amer. Jour. Sci., xxxvi., p. 321.
[5] Ib., p. 222.
[6] Amer. Jour. Sci., xxxvi., p. 324.
[7] Technology Quarterly, May, 1888, p. 407.

have discovered that the brown massive mineral from Newbury, Mass., and regarded by Dana as garnet, is vesuvianite. It has a specific gravity of 3.55 and a composition :—

SiO_2	Al_2O_3	FeO	CaO	MgO	K_2O	Na_2O	MuO_2	P_2O_6
35.93	14.77	8.91	39.46	.13	.44	.36	tr.	tr.

—A hard black mineral occurring at Rome, Mass., in little octahedra, has been examined by Crosby and Brown,[1] with sufficient accuracy to lead them to declare it gahnite.

MINERAL SYNTHESES.—Dollter[2] has effected the synthesis of a large number of *micas* by fusing together aluminium-bearing silicates and metallic fluorides. The hornblendes yielded biotite when fused with sodium and magnesium fluorides. The alumina-free hornblendes gave olivine or augite. Garnets yielded meroxane. Micas of different kinds were obtained by fusing K, Al, SiO_4 with sodium fluoride alone; or with this salt and potassium fluosilicate or magnesium silicate, with or without the addition of ferrous silicate. All the micas thus produced were decomposed when the temperature of the mass was raised to a white heat, and olivine, augite or scapolite were formed. Muscovite was obtained from andalusite by fusing it with potassium fluosilicate and aluminium fluoride, and zinnwaldite, when a little lithium carbonate was added to the mixture. Many other points of interest are found in the paper, which will undoubtedly prove of value in discussing the paragenesis of minerals in rock masses.—Among the other minerals produced artificially within the past few months, attention may be called to *rhodonite* and *tephronite,* which Gorgen[3] obtained by heating to a high temperature, in the presence of water vapor, a mixture of manganese chloride and precipitated silica. Wollastonite[4] was produced when calcium chloride was used instead of the manganese compound. *Barite*, *celestite* and *anhydrite* were obtained[5] by fusing the corresponding amorphous compounds in the chloride of some metal.—Bourgeois[6] fused metallic tin with copper oxide and got crystals of *cassiterite*.—Dufet[7] prepared *pharmacolite* by allowing solutions of calcium[8] nitrate and di-sodium arsenate to diffuse slowly into each other.

MISCELLANEOUS.—Julien believes that the rate of decomposition in pyrite depends upon the amount of marcasite present in it

[1] Ib., p. 408.
[2] Min. und Petrog. Mitth., x., p. 67, and Neues Jahrb. f. Min., etc., 1888, ii., p. 178.
[3] Bull. Soc. Franç. d. Min., x., p. 264.
[4] Ib., x., p. 271.
[5] Ib., xi., p. 58.
[6] Ib., x., p. 284.
[7] Ib., xi., p. 187.
[8] Ann. N. Y. Acad. of Sci., iv., July, 1888.

Easily decomposable pyrite is not pure, but is intimately mixed with marcasite, probably in the most minute, *i.e.*, molecular condition. The more rapid alteration of marcasite is supposed to be due to the open structure of the mineral in consequence of the interlacing of twinned crystals, etc.—Mr. Dunnington[1] thinks that the origin of the massive oxides of manganese may be explained by reference to the well-known dissolving effect of sulphate solutions upon manganese compounds. The sulphates may easily have been derived by the decomposition of pyrites. This theory would account for the great depth at which certain deposits of manganese ores are found, and their concentration in masses.—In an article extending through several numbers of *Nature*, Lockyer[2] gives an interesting résumé of the state of our knowledge in regard to meteorites—their structure, composition and origin.—Rauff[3] announces the invention of a new rock slicing machine, and an instrument for cutting crystals parallel or perpendicular to any given natural face.

BOTANY.[4]

A FEW NOTABLE WEEDS OF THE NEBRASKA PLAINS.—In examining the constitution of various floræ one is struck by the fact that with the other changes there is a notable change in the weedy plants as well. Of course a "weed," from a botanical standpoint, is as reputable a plant as any other. It is in fact but an eminently successful organism in the struggle for place, and on this account it is to the botanist much more interesting than the ordinary plants which jog along in a mediocre way, neither advancing nor falling much behind under our observation. Upon the Nebraska plains, the plants which push themselves into place so prominently as to be called "weeds" by the farmer, are partly natives, and partly introduced species, some of which have come in from the southwest within a comparatively recent period, while others have come along with the tide of immigration from the eastern part of the continent, and from the old world.

The plant which, all things considered, is the worst weed, from the popular point of view, is doubtless the Sand-bur (*Cenchrus tribuloides* L.), a peculiar grass of variable habit. As mostly seen,

[1] Amer. Jour. Sci., Sept., 1888, p. 175.
[2] Ib., Sept., 1888.
[3] Neues Jahrb. f. Min., etc., 1888, ii., p. 230.
[4] Edited by Prof Chas. E. Bessey, Lincoln, Neb.

growing almost horizontally from their bases, but when grown in a dense mass it is a tall, erect grass, reaching the height of eighteen to twenty-four inches, or even more. The heads consist of numerous it is a small plant of a spreading habit, the short flowering stems often spiny flower clusters, which become easily deciduous upon the ripening of the seeds. The spines cause these to adhere tenaciously to the hair of animals or to the garments of the passer-by, and when abundant it is almost impossible to remove them until by hard usage the spines have become worn and broken. The seeds are thus carried long distances before being dropped. The plants thrive upon any soil, from the almost barren sands of the rivers to the rich loam turned up by the railway builders in making their embankments. I am of the opinion that the Sand-bur originally grew upon the sandy islands and banks of the Republican, Platte, Loup, Elkhorn, Niobrara and Missouri rivers, and that from them it has spread since man has broken the tough sod of the plains. It could not compete single-handed with the wild grasses, but as soon as the farmer began his warfare against the latter, the Sand-bur found and improved its opportunity for extending its habitat. The farmer has unintentionally and unconsciously given it the opportunity of going up and taking possession of the land.

Buffalo-bur (*Solanum rostratum* Dunal) is the only appropriate name given to a pest which is rapidly increasing all over the plains. The prickly plant and fruits are almost as troublesome as the Sand-bur. I have seen fields in south central Nebraska almost completely filled with Buffalo-burs. What its original habitat was I do not know, but certain it is that now the plant is accommodating itself to the new conditions brought about by the cultivation of the soil.

The sunflower of the plains is the original of the ordinary sunflower of the gardens (*Helianthus annuus* L.). It is found everywhere, and varies in height from a few inches to fifteen feet or more. Upon the unbroken prairies in the White River country of northwest Nebraska I have seen it growing with the prairie grasses, where it consisted of a single erect stem, not more than ten or twelve inches in height, and bearing a single small flower head. Near by, where the soil had been somewhat broken, as by the washing of water, the pawing of buffaloes, the passage of a wagon, or any other cause, the plants were taller, and with a few branches. Upon the mounds made by the prairie dogs, pocket gophers, and ground squirrels, the plants were still larger, approaching the vigor of vegetation shown by them in the eastern parts of the State. In the settled portions of the State the sunflower grows to a great size, and produces a multitude of branches and flower heads. I have often seen plants whose diameter (measured from the tips of the branches on each side) was fully six feet, and whose height reached

twelve to fifteen feet. It is a curious fact that all over the plains there is a tradition that the sunflower was introduced by the Mormons, who scattered its seeds by their trails, in order to enable the faithful who came later to follow their tracks. It is scarcely necessary to say that this is an error. The sunflower doubtless sprang up in abundance along the Mormon trail, and marked it, but so it did along every trail where the sod had been broken enough to give the plants a better opportunity for growth.

Squirrel-tail grass, as it is called in the books, and in classes in botany, or "Tickle grass," as known to the farmers (*Hordeum jubatum* L. of the botanists), is one of the most abundant of the weedy grasses of the plains. It appears to have originally grown along the sandy margins of rivers, and upon the bare ground about ponds and salt springs, from whence it has spread rapidly to road sides and fields since the advent of white men. It is not naturally one of the prairie grasses proper. In fact, as it is an annual, it cannot compete successfully with the strong-rooted perennial grasses until the latter have been partially displaced by the breaking of the sod; but when once it obtains a foothold it spreads with great rapidity. The jointed rhachis of the head breaks readily into short pieces, each of which bears a few flowers with their widely spreading barbed arrows. Each fragment has a most persistent creeping power, which enables it to work its way through heavy clothing, and the densest of hair or wool. In this way the grains are carried by man and animals for long distances, and when finally the arrows are broken up, and the barbs come out, the seeds are dropped upon the ground, ready to start up in early spring.

Tumble-weeds abound everywhere now, but I am confident that they are likewise dependent for their present abundance upon man's agency in breaking the original sod. The most common tumble-weed is *Amarantus albus* L., well known throughout the prairies and plains. Wherever a settler has broken up a tract of land these plants appear in great numbers; in fact it is principally upon such breakings that they are to be found. In the autumn I have seen great tracts of from fifty to a hundred acres or more entirely covered with the hemispherical or almost spherical examples of these tumble-weeds. With the advent of the frosts and heavy winds of October and November, the stems are broken off at the ground, or in some cases the root is pulled up or twisted off, setting free the round body, which then goes tumbling and bounding over the plains, scattering its seeds as it goes. Whether these tumble-weeds occur as depauperate plants upon the plains, intermingled with the grasses, I do not know, but it is certain that none occur there large enough to roll and tumble. The plant is not a *tumble* weed until it has the opportunity of growing freely upon broken and disturbed soil.

A second tumble-weed is *Cycloloma platyphyllum* Moq. It grows in almost exactly the same way as the preceding. I first observed it along the Platte River, where it covered acre after acre of the sandy river border. It occurs also on the upper Elkhorn River and the lower and middle portion of the Niobrara. However, upon the upper Niobrara and in the White River country the only tumble-weed is *Amarantus albus.* Probably this second plant (Cycloloma) has for a long time been a tumble-weed upon the plains, especially on those portions adjacent to the streams mentioned. Both species will increase in numbers for a few years, during the time when settlers are breaking up large tracts of the prairie sod, and then, as better and more continuous culture is practiced, they will gradually decrease in number and importance.—*Charles E. Bessey.*

Ash Rust in 1888.—The Ash-rust, *Æcidium fraxini,* has been very abundant on *Fraxinus viridis* in Lincoln, Neb., this year. It was especially common in the latter part of June and first week of July. At that time I observed a number of trees of which almost every leaf (as also in many cases were the petioles) was affected to such a degree that many of them were curled and distorted. This has some interest from the fact that, although abundant in 1885, this rust was rare in 1886 and 1887.—*N. R. Pound.*

Hough's American Woods.—During the summer Mr. Romeyn B. Hough, of Lowville, N. Y., brought out Part I. of his proposed work on American Woods, exhibited by actual specimens, and with a copious explanatory text.

The specimens, of which there are twenty-seven, consist of three thin sections, viz., transverse, radial, and tangential, each about four and a half inches by one and three quarters. They are neatly mounted in black cardboard frames, six by nine inches. Upon these frames are printed the scientific name, the various English, German, French and Spanish popular names.

The text is a pamphlet of eighty pages, neatly printed, and illustrated with forty-two wood-cuts. The introductory portion includes an account of the structure of the stem leaf, inflorescence, flower, fruit and seed, with definitions of the technical terms necessarily used in their description. There is also a short discussion of the physical properties of woods. Then follows an index-glossary. Forty pages are devoted to a systematic study of the species represented in the sections. Under each species there is first a specific description of the tree given in quite popular language; then follow geographical distribution, physical properties, uses, medicinal properties, etc. Accompanying this part are three keys to the species: the first based mainly upon the flowers, the second upon the

leaves, and the third upon the fruit. The work will be a most valuable one, and it is to be hoped that it will be continued to completion. Every botanical department ought to afford this set, as the price ($5 per volume) is very reasonable. The volumes are put up in book form, so that they may be placed upon ordinary library shelves.—*Charles E. Bessey.*

ZOOLOGY.

The Contractile Vacuole.—The dispute regarding the nature of the contractile vacuole in the protozoa is not at an end. Dr. De Bruyne records (*Bulletin Roy. Acad. Sci. Belg.* LVI., 1888), his belief that it does not communicate with the exterior, and that it is not possessed of excretory functions. Prolonged study tends to show that the contained fluid is not expelled from the protozoan, but that it is forced to other parts, to again return to form the vacuole. He would rather regard it as of respiratory and circulatory functions and thinks that the contained fluid may possibly have nutrient properties.

An Endoparasite of Amphiura.—Dr. Fewkes records (*Proc. Boston Soc'y. Nat. Hist.*, XXIV., p. 31, 1888) the existence of a Copepod Crustacean parasitic in the brood cavity of the common Brittle Star, *Amphiura squamata*, at Newport, R. I. In the specimens affected the ovary had degenerated into an amorphous mass and that the cavity contained either the adult Copepod or eggs containing the young in all stages of development. Fewkes also records the existence of this parasite in another place (*Bulletin, M. C. Z.*, XIII., 1887) but does not give it a description or a name. Comparison should be made with *Cancerilla tubulata* which is described by A. Giard (*Comptes Rendus*, 1887, p. 1189) as parasitic *upon* the same brittle star at Fécamp. There the young attach themselves to the ends of the anus and approach the disc as they grow older.

The Classification of the Myriapoda.—So far as I am aware, no naturalist has questioned the naturalness and homogeneity of the group of Myriapoda. To me it seems that this unity is apparent rather than real; that the Chilopods and Chilognaths are placed together on account of superficial resemblances, rather than from community of descent, upon which all true classification must be based, and that those features which they have in common are at the same time possessed by all the other air-breathing arthropods.

Every zoologist who has essayed the problem of homology presented by the head and the appendages, has made a more or less conspicuous failure, and this, as I am inclined to believe, has resulted solely from the fact that there is no true homology in these parts. I will not now discuss these points in detail, but will indicate the facts and reasons for my views.

A perfect definition should include all the objects intended to be defined, and at the same time exclude all others. Applying this we find it all but impossible in few or many words to frame a definition which will at once characterize all myriapods, and exclude the hexapods, and at the same time take into account structures which have any morphological value. The best we can do is somewhat after this fashion :—Myriapods are air-breathing Arthropods, with elongate bodies and more than three pairs of walking legs. Farther than this we cannot go, and even this definition will admit Scolopendrella which many now regard as a Thysanure.

Omitting for the present all mention of these features which all Myriapods have in common, we will take up the points of difference between Chilopods and Chilognaths.[1] The Chilognatha (Millepods, galley worms) have a head which bears, besides antennæ, only two pairs of appendages—a pair of jaws or mandibles, and an under-lip composed of the coalesced first maxillæ. To the head succeeds the more or less elongate equally segmented body of which a few anterior segments bear but a single pair of legs, while all the rest bear two pairs of appendages, thus apparently affording an exception to Savigny's law that each segment of an Arthropod can bear but a single pair of appendages. The bases of these legs are placed close to each other, the sternal surface being reduced to an extremely narrow plate, or being entirely wanting.

In the Chilopods, on the other hand, the head bears three pairs of mouth-parts, a pair of mandibles and two pairs of maxillæ while each segment of the body bears but a single pair of walking legs, and these are widely separated at their base by the broad sternal element. Numerous attempts, as was said above, have been made to introduce homology between these two groups in these respects. Heathcotes researches show [2] that that the diplopodous segments

[2] Phila Trans. Vol. clxxix., B. (1888).

of Iulus are in reality double, but they also show that in the head there are no traces of more than two pairs of post-oral appendages.

In the Chilopods the Stigmata which communicate with the trachea, are placed at the sides of the body in the thin membrane joining the dorsal and ventral plates, thus being clearly above and outside the line of the legs ; in Scutiger they are dorsal. In the Chilog-

[1] Pauropus and the Pauropida are omitted because we know almost nothing of their internal structure and their development.

gnaths the stigmata are placed beneath or even in the coxal joints of the legs.

In the genital organs the most marked differences occur. In the Chilognaths both ovary and testis consist of a simple sac-like organ, communicating by a double oviduct or vas deferens with the paired genital openings situated one on either side, at or behind the bases of the second pair of legs. In the Chilopods, on the other hand, the sexual organs possess but a single efferent duct, and this opens in the middle line of the posterior end of the body just below and in front of the anus. In the Chilognaths both ovary and testis are below the intestine, a position indicating inferiority. In the Chilopods they have their origin in the same position which they permanently occupy in the other group, but with development they come to occupy a place above the alimentary tract. The spermatozoa, in the Chilognaths, are quiescent; in the Chiolopods they are active. The position and character of the genital ducts in the Chilognaths is such as to lead to the supposition that here, as in many other metameric forms, they may have had their origin in a pair of segmental organs which have become specialised for carrying away the generative products. Heathcote's account of the development of the generative glands of Iulus certainly does not oppose this view. In the Chilopods, on the contrary, there is nothing in the adult structure (we know nothing of the development) which would even suggest such an origin for the generative ducts.

Now these points are all of considerable morphological importance, as we must, for instance, go far back in the ancestry to find a condition from which we can derive the two types of generative organs mentioned above, and exactly what structure that ancestor must have had it is difficult to say. It is, however, clearly impossible to derive either condition occurring in the Myriapods from the other.

If, however, we turn to existing forms to find the nearest relations of either group, our search is to a certain extent easy, for the next of kin of the Chilopods are certainly found in the Hexapoda. In all those points where Chilopods and Chilognaths disagree, the Chilopods and Hexapods are in harmony. Both have the same number of mouth-parts; both have the appendages segmentally arranged; the spiracles the same, while there is no little similarity between genital organs, ducts,and openings. Indeed taking Scolopendrella into consideration, it seems impossible to frame a definition which will serve to separate all the Hexapods from the Chilopods. It would seem then that we should unite both Chilopods and Hexapods in one class.

With regard to the Chilognaths, it seems not so easy to trace relationships. So far as is apparent, they form a group by themselves with no nearer affinities than those presented by the Anne-

lids. Peripatus, of which so much was expected in throwing light upon the origin of the "Tracheates" seems to fail in this respect, and must be regarded as nearer to the Annelids than to either Myriapod or Hexapod stock.—*J. S. Kingsley.*

Blood Corpuscles of the Lamprey. — S. H. Gage states (*The Microscope*, VIII.) that the blood corpuscles of the lamprey are unlike those of the non mammalian vertebrates and like the mammals in being biconcave, circular and in forming rouleaux. They, however, possess a distinct nucleus, not easily seen in the fresh blood, but rendered visible by staining and by reagents.

Fibres of Short Muscles. — In order to ascertain whether the statement made by Kölliker that in the short muscles of the fish, frog and bat, the fibres are of the same length as the muscle, and have rounded ends, is applicable to the more minute vertebrates, Mrs. S. P. Gage has studied the muscles of the mouse, shrew, bat and English sparrow. She concludes (*The Microscope*, VIII.) that the muscular fibres may extend from end to end or may terminate at one or both ends within the muscle, tapering to a point. She further shows that in the muscle fibres even in the limbs and trunk the fibre may branch at either end and that anastamoses may occur between two adjacent muscle fibres in the mouse; and concludes that the difference between the skeletal and cardiac muscles is not so great as has been supposed.

Notes on the American Trionychidæ. — According to Agassiz there are six species of American Trionychidæ, belonging to three different genera.

I am indebted to Prof. G. Brown Goode and Mr. F. A. Lucas, of the Smithsonian Institution; to Prof. A. Agassiz and Dr. S. Garman, of the Museum of Comparative Zoology in Cambridge;[1] to Prof. A. Gunther and Mr. G. A. Boulenger, of the British Museum, to Prof. O. C. Marsh, of the Peabody Museum, to Mr. T. Gillespie, of Hard Times Landing, La.; for the opportunity they have given me to examine a great number of American Trionychidæ.

As a preliminary report I may note the following conclusions:—

1. The type of *Testudo ferox* Schneider, described by Garden= Pennant in the Philosophical Transactions of London for 1771, is not *Platypeltis* of Agassiz; but a species of *Aspidonectes.*

2. *Platypeltis ferox* of Agassiz is not *Testudo ferox* Schneider, but a new species, which may be called *Platypeltis Agassizii.*

3. *Callinia microcephala* Gray, of the British Museum, with the locality Sarawak, is *Amyda mutica* Les.

[1] To Prof. Angelo Heilprin of the Philadelphia Academy.

According to my researches there are the following American Tronychidæ.

Platypeltis Agass.

1. *Playpeltis agassizii* mihi. = *Platypeltis ferox* Agass. non Schneider.

Aspidonectes Wagler.

2. *A. ferox* Schneider.
3. *A. asper* Ag.
4. *A. spinifer*, Les. = *A. nuchalis* Ag.
5. *A. emoryi* Ag.
6. *A. muticus* Les.

At the same time I should like to call attention to the enormous sexual difference in *Aspidonectes muticus* Les. It is well-known that the males have very much longer tails than the females on all the Trionychidæ. The male of *A. muticus* has the plastron more developed than the female: the Hyo-, and Hypoplastra meet with the callosities nearly in the median line. The callosities extend very much more in the male than in the female; in an adult male the callosities cover the plastral-bones entirely A very peculiar circumstance is, that the adult male is only about half as large as the adult female and that the males are in considerably smaller number than the females. Among thirty-six specimens of *A. muticus* from the Ohio River, there were only *seven* males. The fishermen consider the males and females as different kinds of animals, so great is the difference.

I do not know yet, whether the other Trionychidæ show the same considerable sexual difference. It is very interesting, however, that *Podocnemis* shows it.

Toao Martins da Silva Coutinho,[1] makes the following remarks about the male of *Podocnemis expansa*.

"The male, named *Capitary*, is distinguished from the female, by its size; it is only about 0, 7 m long (the female 1, 2m and more) and the tail which is twice as long, reaches a length of 1. 2 m.—The circumstance that only a small number of *Capitary* are found among hundreds of females, proves, in some way, that a single male is sufficient for the fecundation of a greater number of females."—*G. Baur, New Haven, Conn.*

McGee on Meadow Larks and Riley on English Sparrows.—At a meeting of the American Ornithologists' Union, held in the hall of the National Museum in Washington, Prof. McGee, of the Geological Survey, read a paper detailing his observations upon the two forms of North American meadow larks, as found in Iowa.

[1] Sur les Tortues de l'Amazone, Bulletin de la Société Imperial d'acclimatation, Avril, 1868.

The two species or geographical varieties, whichever they may be, are distinguished by certain peculiarities in their song. The eastern species, *Sturnella magna*, extends about two-thirds way across the State of Iowa, while the western form, *S. neglecta*, is found nearly as far east as the Mississippi River. At their extremes of distribution both of the forms are easily recognized, and are typical examples. But in the intervening region, where the two overlaps, as it were, the birds were not to be positively separated by note alone, a sight of the bird itself being generally necessary for positive identification. Whether the variation in song was due to imitation of one by the other or to an actual intermingling of the two, he did not attempt to decide. In referring to the reason for the distribution of the two species, the agency of the glacial period was evoked. At the time when the ice reached its greatest extension southward, the waters of the Gulf of Mexico extended northward, forming a junction with the ice and dividing the continent into an eastern and a western portion. The suggestion was made that if at a period anterior to the glacial epoch one species was widely distributed over the continent, the time that elapsed until the normal condition of the country was again reached was sufficiently long to allow differentiation to proceed, and two species or distinct varieties to be formed.

In the discussion which ensued Dr. Cones took the ground that a very long period of times was not absolutely necessary for the formation of new races, varieties or species: that environment or food often causes changes with considerable rapidity, and that it is probable new species, so-called, are being formed under changing conditions in our own day and in short periods of time. Dr. Merriam mentioned that changes in coloration are often due to change of food: that a breeder in Holland was so well known for his skill in "coloring up" Flamingoes, that these birds were sent to him from all parts of Europe. By some change in food, a secret known only to himself, he was enabled in a short time to restore them to full color. Yet in a short time the new color was lost and the original faded aspect resumed. Prof. C. V. Riley cited numerous instances of the distribution of insects similar to that of the meaoow larks. Dr. Gill called attention to similar cases with fishes. (It may be well to note here similar parallel cases in the plant world. *Clematis viorna* is a well-known, widely distributed plant of eastern North America, extending, however, only as far west as Kansas, where it is not common. *C. pitcheri*, classed by some as a variety of Viorna, is a western form found nowhere east of the lower Wabash valley in Indiana, but extending westward through Missouri, Arkansas and Texas. It is extremely probable that the two forms owe their distribution to the same cause or causes as the two forms of meadow lark above referred to. Some species of Verno-

nia (Ironweed) seem in similar positions. Four of the species are exclusively trans-Mississippi. One oversteps the boundary into west Tennessee. Two others, on the contrary, are eastern and central species which overlap the others by extending into Iowa and Kansas. It is further interesting to find certain hybrids between the eastern and the western forms, which, if they came from the debatable ground of Iowa, Missouri and Kansas, would furnish additional interest to the problem.

Another paper read at the same meeting was by Prof. Riley, upon the English sparrow. Examination of the stomachs of more than five hundred specimens showed that only from fifteen to seventeen per cent of the whole number contained any insect remains at all. The rest contained grains or seeds of various sorts, straw and gravel. The insects found belonged to all orders, and were generally such as are either harmless to the agriculturalist or even actually beneficial. The stomach of a single specimen of a truly insectivorous bird contained wo hundred and fifty web worms. Such a bird would do more good in ridding trees of various insects than all of the eighty-two sparrows in whose stomachs insect remains were found. Investigations of a similar nature carried on by Mr. Charles Dury, of Cincinnati, lead to a similar conclusion, that the value of the English sparrow as an insect destroyer is nothing compared to that of a truly insectivorous bird, and that it is injurious rather than beneficial.—*Jos. P. James.*

BROCAS CONVOLUTION IN THE APES.—Dr. Hervé in the *Bulletin de la Société d'Anthrpologie de France* (April, 1888), discusses the disputed question as to the development of the third (Brocas) frontal convolution in the monkeys. After an examination of the homologies of the fissures presented by that region of the brain, he finds that it is wanting or extremely rudimental in the Quadrumana, while it is present in the Anthropomorpha, though smaller in the apes (Simiidæ) than in man. This is interesting, as it confirms the evidence from the osteology, that the apes and man form a natural group, distinct from the monkeys and lemurs. It also points to the possibility of teaching some of the apes to speak, and also to the probable gradual acquisition of this important characteristic of man.—*E. D. Cope.*

ZOOLOGICAL NEWS: PROTOZOA.—In the *Zoologischer Anzeiger* (No. 286), G. Cattaneo called attention to the existence of a parasitic ciliate infusorian (*Anophrys maggi*) in the blood of the crab, *Carcinus mœnas.* In the same Journal (No. 292) Géza Entz describes the occurrence of another Ciliate (*Nyctotherus cardiformis*) in the blood of *Apus cancriformis.*

Rupert Valentin records the presence (*Zool. Anz.*, 292) often in comparatively large numbers of psorosperm masses in the tissues of two species of Lucernaria. In each mass the spores were in various stages of development.

Franz Leydig also calls attention to the fact that in 1860 he described parasites in the blood of Daphnia, Lyncius and Cyclops, and complains that he also called attention in his Natural History of the Daphnidæ to their existence in the blood and other tissues of sick silkworms, a fact which has been overlooked by all subsequent students of the diseases of the silkworm.

Dr. Stokes describes a number of North American Flagellata in *Jour., of the Royal Microscopical Society* for October. The forms are *Mastigamœba flexuosa, Cercomonas truncata, C. heterofilum, C. lapsa, C. undulans, C. mutabilis, Heteromita granulifera, H. tremula, H. stagnalis, H. sphagni, H. nasuta, H. parvifilum, Tetramitus frondarius, Hexamita truncata, Atractonema pusilla, Hymenomonas flava, H. fusiformis, Zygoselmis obovata, Stereomonas parvula, Anisonema obliqua, Hymenona* (nov. gen.), *sphagni*, and *Petalomonas orbicularis.* There is no definite locality assigned to any of the species.

Mr. C. D. Sherborn has recently published in London a volume of 152 pages, devoted exclusively to a bibliography of the Foraminifera, recent and fossil.

Sponges.—Wierzijski (*Verhandl. k. k. zool-bot. Gesellsch.*, Wien, 1888) thinks that all the so-called species of Euspongilla are but one in reality, the differences being the result of environment. He also found near Lunberg a sponge which he regarded as closely allied to Pott's *Spongilla terrænovæ*, but afterward concluded that both his form and the Newfoundland species were deformed individuals of *Myenia mülleri.*

Cœlenterates.—Vogt thinks that Arachnactis is not, as the younger Agassiz thought, the young of the Edwardsia but a distinct genus allied to Cerianthus and like the latter retaining its distinctly bilateral character throughout life. Though he does not expressly say so, Vogt is apparently ready to adopt the view that in the Hydrozoa as in the Anthozoa the free-swimming form is the primary and the attached condition secondary and adaptive.

Worms.—O. Zacharias records (*Biol. Centralblatt*, VIII., p. 542) the occurrence of a land planarian (*Geodesmus terrestris*) between the gills of the mushroom (*Agaricus deliciosus*).

About two years ago we referred to the account given by Dr. Walker, of Buffalo, concerning the life history of the tape worm of

fowls. He claimed that the intermediate host of the worm Syngamus was to be found in the earthworm. Recently (*Nature*, XXXVIII., p. 324) Lord Walsingham gives facts collected from the experience of sportsmen which tend to corroborate this view. In dry summers when but few earthworms come to the surface, game fowl are comparatively free from the disease, but when worms are abundant, the fowl are more difficult to rear.

G. Brandes, in a preliminary communication embodying his anatomical discoveries, points out that the Trematode H*olostomum* has been regarded wrong side up, the "ventral" surface of authors being really dorsal and that the "larval anus" of the Tetracotyle stage of the worm is but the beginning of a gland and its duct, the alimentary canal ending blindly in the body parenchyma.

Dr. J. W. Fewkes describes and figures (*The Microscope*, 1888) a new type of marine larva found in the Bay of Fundy, and in Massachusetts Bay, which is regarded as having brachiopod, chætopod, and bryozoan features, but which seems to be nearest Mitraria in its affinities. The adult to which it belongs is unknown. Fewkes, in conclusion, has some remarks upon the characters of the common ancestor of Polyzoa, Brachiopoda, and Chætopoda, which lead him to suggest as a name for this hypothetical form "that of Mitraria, which up to the present is applied simply to the larval form of a single genus of Chætopoda."

Iijima and Nusata record some new cases of the occurrence of *Bothriocephalus liguloides* in Vol. II. of the *Journal of Science* of the University of Tokio.

Mollusca.—Some sixty years ago Desmarest and Lesueur proposed to issue a series of illustrations of Polyzoa and Hydrozoa, and fourteen plates were engraved on copper by the latter. A few of the plates were distributed, but no accompanying text was ever prepared. Recently E. Pergens (*Procès-Verbal de la Soc. Roy. Malacol. Belg.*, Sept., 1887) has examined the original manuscripts and the types preserved in Havre, and has given identifications of the Polyzoa there figured.

Protozoa.—The Martini-Chemnitz "Conchylien-Cabinet" still appears at intervals. Numbers 356 to 361 have recently appeared, containing plates of Cardita, Pecten, Spondylus, Cerithiidæ, Chama, Cardita, Solen, and Modiola.

Paul Pelseueer denies (*Bull. Scientif. France et Belgique*) the existence of a group of Orthoneurous Gastropoda.

Crustacea.—According to the *Journal of the Royal Microscopical Society*, D. Bergendal has described the occurrence of distinctly male copulatory appendages on female crabs. In many cases there

were no appendages on the first segment of the abdomen; in others spoon shaped; in a few like those of the male. Only the useless and normally rudimentary first pair of appendages show this modification, the second pair which are functional are never modified in this way.

TUNICATA.—Prof. Herdman, in the *Proceedings of the Biological Society of Liverpool* (1887, p. 24), thinks that recent investigations tend to establish that the pineal gland and the pituitary body of the Vertebrata, are both of them the remains of organs which reached the surface of the head in the ancestral Chordata, the pineal in the form of a median dorsal organ of sight; the pituitary possibly also as a sense organ placed on the front of the head close to the mouth opening.

BIRDS.—Dr. R. W. Shufeldt contributes to the *Auk* (Vol. V., Oct., 1888) figures of the skulls of *Habia melanocephala* and *Pipilo megalonyx*, from which he shows that the grosbeaks are possessed of skeletal characters not shared by any other fringilline birds, and are possibly entitled to family rank.

Mr. N. S. Goss, of Topeka, Kansas, wishes information concerning the western range of *Anas obscura*, the black duck. He is inclined to doubt its occurrence west of the Mississippi, all the specimens which he has examined proving to be the Florida duck.

MAMMALS.—At the meeting of the Linnean Society of New South Wales, Aug. 29th, 1888, Professor Tate exhibited a salted and sun-dried mammal from Alice Springs, Central Australia. In general appearance the animal resembled a Cape Mole (Chrysochloris). Its teeth and limbs indicated an insect diet and a burrowing life. Though no marsupial bones were seen on cursory examination, the marsupial character was shown by marginal folds bordering the lactiferous area, which also, together with some other points, indicated affinity to the Monotremes as well. The dentition is said to resemble that of the purassic genera. According to the natives it was the second specimen seen for sixteen years. A full description will be given later by Mr. Zietz, of the South Australian Museum.

ENTOMOLOGY.[1]

On the Methods of Experiments in Economic Entomology.[2]—The establishment by the United States Government of an agricultural experiment station in connection with each of the state Agricultural Colleges has resulted in a great increase of attention to experiments in economic entomology. This increased attention has brought clearly to light the inadequacy of the methods commonly employed in experiments in this field. In fact the state of entomological science is such that he who wishes to conduct careful experiments, except in a few simple lines, is first forced to develop the methods of investigation.

Although there are many entomologists engaged in research, and although the literature of the subject is a vast one, more than a score of journals being exclusively devoted to this specialty, comparatively little is done in the study of the transformations and habits of insects, or in making practical applications of entomology. With the exception of a few government entomologists, the energies of the workers in this field are almost entirely devoted to the description of species. And although a few workers have achieved very important results in the study of the habits of insects, and in making practical applications of the facts observed, they have done this with very crude apparatus, and often by methods which cannot be relied upon to give exact results. While magnificently equipped laboratories of physiology and histology are springing up at all of the scientific centres, the student of the habits of insects contents himself with a few breeding cages scarcely better than those used by Réaumur a century and a half ago.

An illustration of the imperfection of the methods commonly employed is the fact that experiments with insecticides are usually conducted only in the field, where the conditions cannot be controlled. I have before me a report of an experiment made to test the efficiency of a certain substance as an insecticide. The insects experimented upon were root-feeding larvæ. A careful examination of the field made at the close of the experiment revealed five times as many larvæ upon the roots of the plants treated with the supposed insecticide as there were upon an equal number of plants that had not been treated. It is evident that the application had no effect as an insecticide. But would this conclusion have been so evident had the Experimenter happened to have treated the

[1] This department is edited by Professor J. H. Comstock, Cornell University, Ithaca, N. Y., to whom communications, books for notice, etc., should be sent.

[2] Partly from the advance sheets of the Report of the Cornell University Experiment Station for 1888.

PLATE XXIX.

THE CORNELL INSECTARY.

second lot of plants instead of the first? Would it not have appeared that four-fifths of the insects had been destroyed?

While it is evident that ultimately we must depend upon field experiments for demonstrating the value of methods of preventing the ravages of insects, the danger of error in such experiments is so great that it is unwise to depend upon them in working out principles upon which such methods are based. Obviously the worker in applied entomology needs a laboratory and apparatus as much as does the chemist or physiologist; and this laboratory should be different from our ordinary entomological laboratories.

The greater number of subjects which a worker in this field should investigate fall under two heads: first, studies in the life-histories of insects: second, experiments in the destruction of noxious insects or of preventing their ravages. Work in neither of these lines can be well done in an ordinary entomological laboratory. In order to make accurate investigations of this kind it is necessary that there should be a place where living plants can be kept with insects upon them, and that all of the conditions of growth of both plants and insects should be under control.

We have already given an account (*Ante*, p. 468) of the Laboratory of Experimental Entomology at Cornell University. A view of the exterior of this building is now furnished our readers. Plate XXIX.

Soon after the erection of this laboratory we found that it was desirable to designate it by a name which should distinguish it from the entomological laboratory of the University where instruction is given. As this, so far as we know, is the first building of its kind, we were forced to coin a word; and have proposed the name *Insectary* for buildings arranged for keeping or raising living insects.

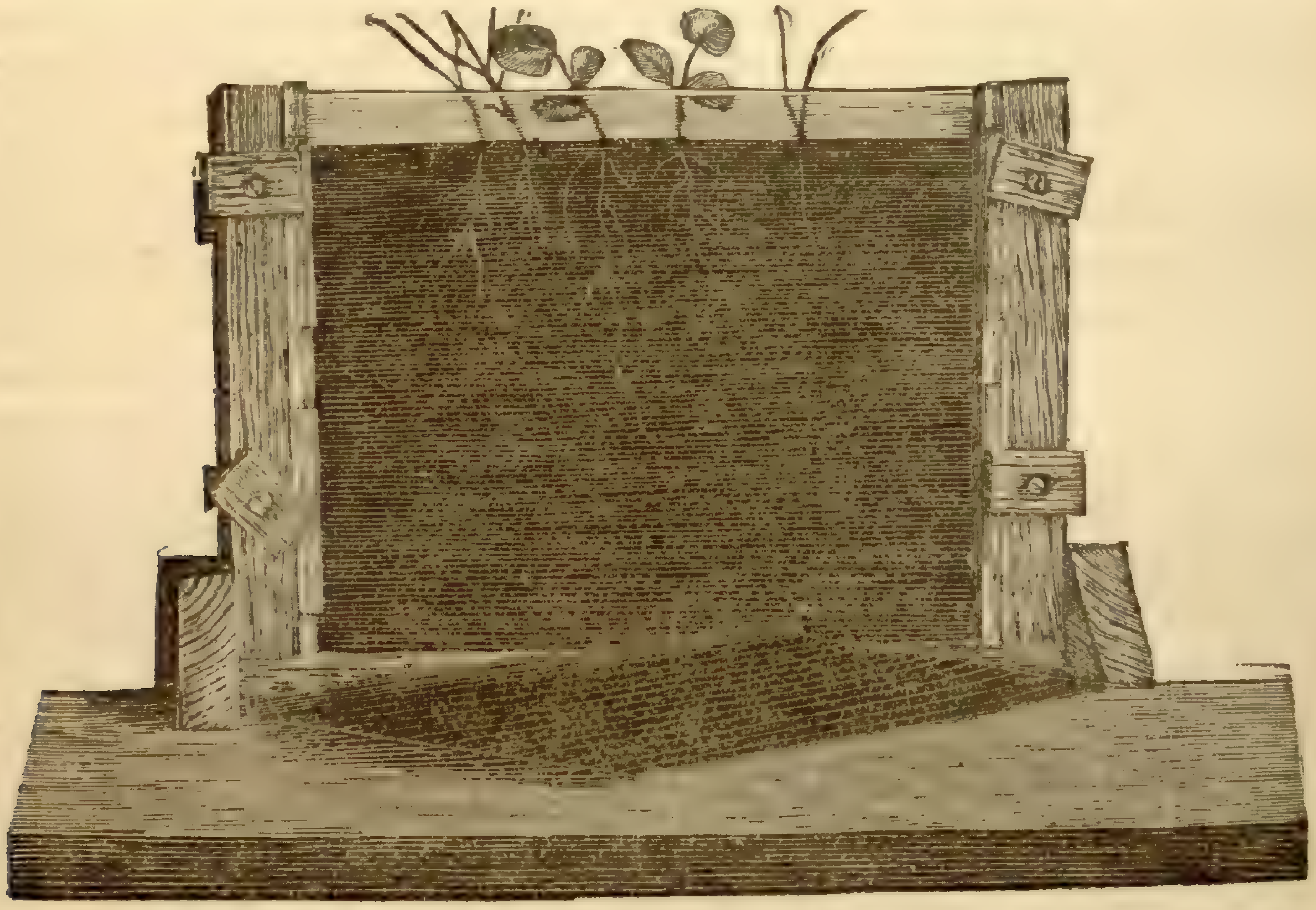
We hope that the time is near when the need of an Insectary for entomological work will be as fully appreciated as is the necessity for a propagating house for the horticulturist or a conservatory for the botanist.

But the building is not all the equipment required for the entomological work of the future. We need specially constructed apparatus for this work. The breeding-cages and the methods of observation and preservation of specimens which we have inherited from the last century will not meet all the requirements of the complicated problems we have to solve. There must be more accurate methods of observing the habits and transformation of insects, more perfect ways of testing insecticides, and better means of preserving specimens for study. It is not too much to hope that the methods of entomology of the year 1900 will be as much in advance of those of to-day, as the present methods of histology are in advance of those of fifteen years ago.

With the hope of stimulating the study of methods, I present

below descriptions of a few simple devices which I have found of much use in my entomological work.

The most important of these is a device for observing subterranean insects. This device I have termed a root-cage. It consists of a frame holding two plates of glass in a vertical position, and



only a short distance apart. The space between the plates of glass is filled with soil in which seeds are planted or small plants set. The width of the space between the plates of glass depends on the width of two strips of wood placed between them, one at each end, and can be varied according to the necessity of each experiment. Outside of each glass there is also at each end a strip of wood for holding the glass in place. The strips are fastened by means of wedges forced between them and buttons projecting beyond the edges of the end pieces, as shown in the figure. It is necessary to have wedges upon only one face of the cage. By making the three strips of wood at each end of the cage (one between the glasses and one outside of each), of different widths and interchangeable, the width of the space between the glasses can be easily varied. Immediately outside of each glass there is a piece of blackened zinc which slips into grooves in the strips at the ends, and which can be easily removed. When these zincs are in place they keep the soil dark. In the first lot of root-cages that I had made holes were bored in the bottom to provide for drainage. But the danger of the escape of insects through these holes has led me to depend on the leakage of the water through the cracks between the glass and the wood. A layer of very coarse sand one inch in depth at the bottom of the space between the glass facilitates drainage.

If the space between the two plates of glass be very narrow, when the seeds which have been sown in this cage germinate, a large part of the roots will ramify in the soil so near the surface of the glass that they may be easily seen by simply removing the piece of zinc already described. When the plants have become well established they may be infected with the insect pest to be studied, and continuous observations can be made without disturbing them. Thus at the present time I have corn growing in these cages with wire-worms feeding upon its roots. In other cages I have clover growing, the roots of which form an almost continuous mat on the inner surface of the cage. Better results can be obtained in this way than by going into the fields and digging up plants; for in most cases the moment plants are dug up the insects stop their work, while in these root-cages continuous observation of the same insect is possible.

I have had constructed several large root-cages, the frames of which are of iron, and each side of which consists of eight lights of glass, each ten inches by twelve inches in size. A pit has been dug for the reception of each cage; these pits are walled with brick. When the cage is placed in the pit, the top of it is even with the surface of the ground; by excluding the light from this pit it is hoped that the roots can be kept under nearly normal condition. These cages have been constructed for larger plants; thus we purpose to plant apple-trees in some, for the study of the root form of the Woolly Aphis of the apple; grape-vines in others in order to observe the Grape Phylloxera; and hop-vines in still others for use in proposed experiments upon the Hop Plant-louse. These cages are lifted from the ground when it is desired to study them by means of a small portable derrick.

Another form of breeding-cage which I have found very useful is made by combining an open-top bell-jar and a flower-pot. The food plant of the insect is either growing in the pot or is stuck into wet sand in the pot and kept fresh as a gardener would keep a cutting. A large saucer is used, and an inch or more of sand is placed in it. The bell-jar is placed over the plant in the pot and pressed down into the sand in the saucer. The open top of the bell-jar is covered with swiss muslin. The plant or cutting can be kept well watered by pouring water into the saucer without removing the bell-jar. The layer of sand in the saucer saves from drowning those insects that crawl down from the plants. The circulation of air through the muslin at the top prevents the formation of mould.

I have long used jelly-tumblers and fruit-jars for breeding small insects and for storing pupæ. I have been much annoyed by inability to preserve the proper degree of moisture in these receptacles If they are supplied with moistened sand and closed tightly the

specimens soon mould; if covered by muslin the sand in a short time becomes too dry and the specimens, if they emerge at all, are apt to do so in a crippled condition. I have obviated these difficulties by boring a hole in the bottom of the jelly-glass or fruit-jar and setting it in a flower-pot saucer. By pouring a little water into the saucer from time to time, the sand in the jar can be kept moistened and the excessive wetting caused by pouring water upon the sand avoided. The holes in the glass are bored by means of the end of a broken rat-tail file wet with turpentine.

Other forms of new apparatus are in use, but they are not sufficiently perfected to warrant description at this time.—*John Henry Comstock.*

EMBRYOLOGY.[1]

Development of the Peripheral Nervous System of Vertebrates.—Dr. Beard[2] continues his important studies on this subject, which is just now interesting some of the most distinguished of living students of the general ontogeny of the vertebrates. His results as to the origin of the ganglia of the posterior sensory roots of the spinal nerves, and of the sympathetic system, are startling and unexpected. His discoveries may also be ranked as fundamental, and amongst the greatest of recent times, as regards their consequences. The following résumé of his conclusions is given in his own words:—

"The spinal ganglia of vertebrates are formed as differentiations of the inner layers of the epiblast just outside the limits of the neural plate. As the result of the cutting out from the epiblast of these ganglionic elements an appearance is presented by the epiblast which is left, to which Professor His gave the name of 'Zwischenstrang.' This has no share in the formation of the ganglia. The 'Zwischenrisme' of His has no existence, but certain portions of the cranial ganglia, called here neural ganglia, are developed from the epiblast before closure of the neural tube, *in exactly the same way as the spinal ganglia.* These portions of cranial ganglia are more or less homologous with spinal ganglia, possibly only with the sympathetic portion of the spinal ganglia 'Anlagen.' After separation from the epiblast, the neural cranial ganglia and the

[1] Edited by Prof. Jno. A. Ryder, Univ. of Penna., Philadelphia.

[2] Morphological Studies, II. The development of the peripheral nervous system of vertebrates, Part I., Elasmobranchs and Aves, Quar. Journ. Mic. Science, xxix., pt. ii., 1888, pp. 153–227, pls. xvi.–xxi. By J. Beard, Ph.D., B.Sc.

spinal ganglia get carried up with the closing in of the neural tube, and come to lie between its lips, but are quite distinct from the central nervous system, and the line of boundary between the two can always be distinguished. After the closure of the epiblastic folds the 'Anlagen' grow out of their position between the lips of the neural tube, and acquire their first and only connection with it by the probable growth of fibres from the ganglia into the central nervous system. The neural cranial ganglia also grow towards the lateral epiblast at the level of the notochord, and fuse with it. Here are the Anlagen of the lateral or branchial sense organs of Froriep and myself. From this fusion in all vertebrates form-elements pass into the cranial ganglia; these form-elements I distinguish as lateral ganglia. The parapodial ganglia of Annelids appear to be homologous with the spinal ganglia of vertebrates, as Kleinenberg suggested, and also more or less with the neural cranial ganglia.

"The anterior roots of cranial and spinal nerves arise as outgrowths of ganglia situate in the central nervous system. To form them, cells leave the nervous system and are distributed in the nerve. All the anterior roots at first contain many nuclei, which are of nervous and not parablastic origin. These statements on the anterior roots are only a confirmation of Balfour's researches.

"In addition to the four elements of the anterior and posterior roots, two ganglionated and sensory, two motor and unganglionated, distinguished by Gaskell, Hill, and partially by His, the cranial nerves contain a fifth element, derived from the lateral or branchial sense organs. Such are, in very brief form, the main results of the researches recorded in the preceding paper."

Dr. Beard shows that the so-called "neural ridge" of Balfour is developed from a portion of the epiblast hitherto overlooked by embryologists, and extending along either side of the medullary plate, and that it precedes by a very considerable interval of time the appearance of the "neural ridge" to which it gives rise and from which the spinal and sympathetic or neural ganglia are subsequently developed.

Further observations have been communicated by Dr. Beard to the *Anatomischer Anzeiger*, III., No. 29, 1888, pp. 875–884 (to be continued in No. 30) on this same subject. His completed results will be published in three parts: Part I., discussing the development of the peripheral nerves in Elasmobranchs and Birds; Part II., Frog, Triton and Lacerta; Part III., Mammalia. Of these, only Part I. has yet appeared in the journal cited below in full.

It is stated in the conclusion of the first part of the article in the *Anatomischer Anzeiger* (p. 884), "It can be proved embryologically that of the following cranial ganglia each and every one is made up of two parts, a neural part and a lateral part, which are devel-

oped respectively from the sources mentioned above, Olfactory ganglion, mesocephalic, trigeminus, facial, auditory, glossopharyngens, and vagus complex." In a foot-note it is stated, "I hope soon to show that the end-organs of taste arise from such thickenings [of the sensory epithelium] which have wandered through certain gill-clefts into the buccal cavity" (*Anat. Anz.*, p. 879).

A NEW ATLAS OF EMBRYOLOGY.—Nothing to compare with the splendid atlases of Coste on Comparative Embryology, and of His on the human embryo, has yet been published on the Chick. This desideratum will be met by the *Atlas d'Embryologie*, by Mathias Duval, just anuounced by G. Masson, Paris. The author has done wisely in keeping it in quarto form, and with forty plates, embracing 652 figures, it will cover the history of bird development very fairly. The first plate gives views of the egg in the ovary and oviduct, and the chick in the egg nearly ready to hatch, in short, a "vue d'ensemble de sujèt." The next two plates are devoted to the structure of the egg, segmentation and formation of the blastoderm. Plates IV. to X. show surface views of the blastoderm and embryo at successive stages. Plates XI. to XL. are devoted to representing sections of the successive stages shown entire on Plates IV. to X. Facts only are presented, theoretical considerations being left to the student after he has mastered the data. The whole is provided with a copious index, and also contains an account of the necessary embryological technique involved in a study of the developmeut of the chick. The reviewer predicts that Professor Duval's work will be welcomed by teachers as a very useful help in the practical study of the subject in the laboratory. The book will be useful for reference to supplement other manuals, and, as it seems to the writer, a thorough knowledge of the embryology of the chick will best serve as an introduction to the wider field of comparative embryology. The appearance of this atlas is timely, for it is probable that eventually embryology will have to be taught in order to enable the beginner in morphology to understand the significance and relative importance of the data of advanced morphology in general.

In taking a survey of the field of embryology, as covered by the existing literature, one is struck by the fact that, in spite of the great activity of the individual workers, but few really exhaustive monographs provided with adequate atlases are in existence. Such beautiful embryological monographs as Goette's on Bombinator, of Reichenbach on the Cray-fish, are lasting contributions to science; the works of Selenka and Whitman, too, and, amongst the productions of the older workers, the great monographs of Von Baer, Rathke and Bischoff, must ever command admiration. Complete

as some of these are, we are still deplorably deficient in monographies which serve to illustrate the later or post-embryonic changes, intervening between the last stages with which the embryologist cares to concern himself, and the point where the organism becomes adult, when it is supposed that the scalpel of the anatomist is all-sufficient in prosecuting farther inquiry. This is unfortunate, since the details of the final metamorphosis of whole systems of organs, even in animals as thoroughly studied as the chick, is in some cases scarcely at all known, or so imperfectly as to be nearly the same as if altogether unknown. The external features of the development of the skeleton of the chick are pretty well known, but the internal and histological changes, and the development of pneumaticity of the bones, quite imperfectly.

Now that serial sections may be so easily prepared and photographed upon an enlarged scale, it is strange that no one has yet undertaken to prepare sets of uniformly enlarged photographs of series of sections, arranged in a folio in the order in which they were cut, of the most important stages of the development of the chick, and thus supply a more satisfactory iconography of the embryology of this animal than we yet possess. Series of enlarged photographs of serial sections, arranged as suggested, if made with care, would serve almost as well for purposes of reconstruction as the modelling method of Born, or the method of graphic isolation proposed by Kastschenko. It would, in fact, make it possible to inspect series of sections of an organism with as much readiness and as minutely as one is enabled to inspect the successive pages of a book. In fact, the topography or relations of the organs, as well as some notion of their histological composition, in an embryo, in successive planes, could be as readily got at in this way as the text imprinted upon the pages of a book. If thin gelatine positives of such series were properly prepared, protected, and arranged in their proper serial order, in the form of a roll, series of sections could be projected, one section after the other in succession, upon a screen for purposes of lecture demonstration, in a manner far more effective than would be possible with the most complete serial sets of diagrams.—*J. A. R.*

ARCHÆOLOGY AND ANTHROPOLOGY.[1]

ANTHROPOLOGICAL SOCIETY OF WASHINGTON.—Prof. O. T. Mason, of the National Museum, read an interesting lecture on the subject of "the Human Beast of Burden." He viewed the subject from an anthropologic standpoint. He began with transportation and commerce in prehistoric times. Men and women were the first beasts of burden, and all aboriginal carrying was done on their heads and backs. Even the improved state of civilized society has not extinguished all traces of this, for human carriers are still numerous. Hod-carriers have been but recently, and, indeed, partially, superseded by elevating machines. The great progress of the time has been such, continued Prof. Mason, that no one walks nowadays, unless it is a preferred exercise; horses, steam and electricity lend their aid to whirl people to their destinations.

He enumerated the various methods by which the human beasts of burden perform their carrying tasks. First by hand, the right hand. He said he had examined a great number of savage implements designed to be carried in the hand, and that the proportion of those shaped for use by the left hand was not greater than 1 to 50; in no case did he find a left-hand female implement. Then both hands are used, after which the fingers come into play. Illustrating the use of the fingers in carrying he mentioned the summer-resort waiter, who bears his tray aloft on three fingers. The baldric is next in order, slung over the shoulder by a strap and hanging on the hip. In this way hunters carry game and travellers carry small satchels. Then, still progressing, goods to be carried are to be hung to a belt. Hanging things on the arm may be called the retail method of carrying, and is used by farm hands, servants, porters, in fact a large proportion of the people we meet in any place. While a civilized being will twist his form so as to get the load that is hung on his arm supported by his back, a savage will never be found doing so. Next comes the hanging over the shoulder. This method is used by grain porters and hod-carriers.

The oriental porters carry almost exclusively on their shoulders. A coolie's average load is 100 pounds, with which he will make 30 miles a day. It is estimated that there are 1,000,000 tons of material moved by coolies in China each day. Then both shoulders come into use, the load being placed around the necks, after which an easy progression is to the back, which is the natural carrying-place of the burden. The soldier carrying his knapsack and rations, is a good example. Then loads are carried on the head, a

[1] This department is edited by Thomas Wilson, Esq., Smithsonian Institution, Washington, D. C.

process called "toting." The negro as a domestic example, and the dairymaid, are reputed to carry their milk pails on their heads, and there are many other illustrations of this mode of transportation. Certain tribes of Indians wear straw rings on their heads to aid in bearing and balancing these great loads. Pockets, remarked Prof. Mason, are scarcely worth mentioning as a civilized means of transportation, although the flowing robes of a Chinaman are capable of concealing at least half a bushel of playing cards, a capacity that deserves passing notice. The carrying power given by these various modes is augmented by means of combinations of men, in illustration of which the vast works in Egypt and other eastern countries were cited. Men also carry goods by traction, that is, by drawing over the ground. First, the arm alone is used, then a line is fastened to the object and the person. It is held in the hand over the shoulder, wound around the waist or over a pole. The hunter drawing home his game is a primitive example of this means of carrying. Throwing is sometimes resorted to as a means of transportation, of which the method of handling bricks by tossing them from hand to hand is a fair sample. Dirt and excavated material were at first carried in sacks, which have been superseded by shovels. The great necessities and the differentiating progresses of civilization for rapid and safe transportation give rise to the professional carriers.

The Fifth Annual Report of the Bureau of Ethnology.—This Volume for 1883–'84 has just appeared. It contains about 600 pages in quarto form, the report of the Director, Major J. W. Powell, filling about 50 pages. The accompanying papers are as follows:—

One on Burial Mounds in the northern section of the United States, by Prof. Thomas. He describes the burial mounds of the Wisconsin district, of Illinois or upper Mississippi, of Ohio, and of the Appalachian district, and elaborates the favorite theory of the Bureau of Ethnology, that the Cherokee Indians were the principal mound-builders of the United States. He reports the discovery made by the exploration of the great and small Etowah mounds in Bartow county, Georgia, and many of the objects found therein are shown by means of illustrations.

Chas. C. Boyce, Esq., gives the history of the treaties made between the United States and the Cherokees. He gives the material provisions of all treaties made, together with their historical data, from that of November 28, 1785 to April 27, 1868. His paper is quite full and seems to have exhausted the subject. It fills 250 pages.

Dr. Washington Matthews, of the United States Medical Museum, furnishes the Mountain Chant, a ceremony belonging to the Nava-

jos. This is a comparatively new field for anthropological research, and Dr. Matthews has been the principal husbandman. His paper is deserving of high encomium. It is beautifully illustrated, and shows the author to be as equally successful as a poet and historian, as he has been in anthropology and medicine.

Rev. Clay MacCauley devotes fifty pages to the Seminole Indians of Florida. He describes their personal characteristics, physique, costumes, and personal adornment; their society and tribal life, their industries, arts, and religion, and makes a valuable contribution.

Colonel James R. Stevenson might have been well denominated the soul ol the Bureau of Ethnology. He was the discoverer of its protoplasm, and was its Executive officer during the greater part of its existence, until his death in August, 1888, at the Gilsey House, New York City. This is no place for panegyric upon his abilities. Whatever of honor and credit, history shall mete out to him for his anthropologic researches among the Zunis and other Indians of the interior and western United States, must be fairly divided with his wife. She accompanied him in all, or nearly all, his explorations, and her zeal, ability, faithfulness and address in procuring the more difficult secret information concerning the inner life of Indians and Indian women, of their mythology, of their religious societies, of the ceremonies by which they were carried on, can never be fully portrayed or thoroughly understood. His contribution to the present volume is the "Religious Life of the Zuñi Child." Her paper is illustrated by four full-page chromo-lithographic plates, illustrative of the masks, dresses, and other objects used in the ceremonies which she describes.

Some Superstitions of the Bahama Negroes.—Some years ago, while in the employment of the Bahamas Government, I spent a month in exploring the island, or rather islands, of Andros, in the west of the Bahama archipelago. The negroes of the northern part of Andros are physically the finest in the colony, and are also superior in other ways, in spite of their bad repute in Nassau. It is said that during the Indian wars in Florida numbers of Indians made Andros their temporary home, but they appear to have mixed very little with the negroes. One old man, however, who was my host during my stay in the island, says that his grandfather was an Indian, and his appearance bears out the statement to some extent, his color being of a reddish brown, his features Indian in their cast, and his hair not woolly but in long curls.

The settlements in Andros are all along the East coast, the interior being a great swamp, with occasional ponds, and island-like patches of coral-rock, covered with pines, scattered throughout it. I found that many of the negroes possessed curious superstitions respecting the interior, which they rarely visited. One of my men

told me that the pine woods were inhabited by creatures called "Yayhoos" (Query, has the name come from Dean Swift?), big, black, hairy beings who walk about in "schools," the biggest first, "and if they catch you, they tear you." The only way of putting these creatures to flight was by waving a torch at them. There were also small, black beings like little men, who were called "little people," who lived in the branches of the pines, and if one pointed a finger at them, one fell down a cripple. These had been seen by the father (of course, dead) of my informant. These superstitions would appear to relate to the gorillas and monkeys of the West Coast of Africa, and to have been handed down from the original African slaves to their children. The pine woods were also said to be inhabited by "mermaids" of both sexes, the name being used indiscriminately, who occupied themselves in the traditional way combing their hair.

An eerie story was told me by my old host. Once, in his father's time at one of the southern settlements, a woman left two of her children at home while she went to the fields. On her return, she found that the younger, a mere infant, had disappeared, and that the elder could not say what had become of it. The well was searched, and parties of men hunted through the bush, but for some time without result. On the third day, however, some of the men heard cries, and forming a ring they gradually reached the spot whence the cries came. There they saw an awful sight; the missing child was held by a *thing* without head or arms or legs, and more like one of the great, brown ants' nests than anything else. When it saw the men, the thing appeared to be afraid, and threw the child on to a mass of "love-vine," trailing from a neighboring tree, and then made off into the bush. The men, horribly frightened, took to their heels, except one, who took up the child from the ground to which it had fallen, and carried it home. The child's body had become like jelly, and it only lived a day or two. This story appears to be "made out of whole cloth," and the conception of an ant's nest, headless, eyeless, limbless, yet capable of seeing, moving, throwing, is grotesque even for a negro imagination.

The negroes of the Bahamas show far fewer effects of white influence than those of the United States, or even of the other West India Islands. Even in New Providence they have customs which, I fancy, are not found in the South, such as the fire-dances, the election with great ceremony of queens of the Congo, Yuruba, and Ebo tribes, etc. A belief in Obeah is prevalent, and probably also Voodooism, but it is excessively difficult for a white man to obtain any information on the matter, in New Providence, at least. In Andros there might be fewer difficulties in the way, for the confidence of the negroes there is easily won, if they be well treated.

MICROSCOPY.[1]

THE PROCESS OF STAINING SECTIONS SIMPLIFIED BY MIXING THE STAINING FLUIDS WITH TURPENTINE.—According to Dr. Kükenthal's experiments, a large number of coloring substances admit of being mixed with turpentine, and serial sections may be stained in a short time by such a combination. Methyl-green, methyl-blue, gentian-violet, safranin, Bismarck-brown, eosin, fuchsin, tropæolin, and malachite-green may be used in this way.

The dry coloring substance is dissolved in *absolute* alcohol, and the solution dropped into turpentine until the mixture has any intensity of color desired.

Meyer's[2] Carmine Solution.

Absolute alcohol	100 cc.
Pulverized carmine	3 gr.
Hydrochloric acid (neutralized with ammonia)...	25 drops

Can be united with a mixture of turpentine and absolute alcohol [in equal parts ?], and in this form used for staining sections.

The method of using these stains is very simple. The sections are fastened to the slide by Schällibaum's collodion, then left in the oven of the water-bath until the clove oil has been completely driven off. The paraffine is next removed by washing in turpentine, and then the slide is immersed in the staining mixture. As soon as the desired depth of stain has been received, the sections may be washed in pure turpentine and mounted in balsam.

If the stain is too deep, or a sharp nuclear stain is desired, it is only necessary to leave the slide a short time in a mixture of turpentine and pure (free from any trace of acid) absolute alcohol, and the color will be reduced.

The coloring mixture may become cloudy, as the result of the evaporation of the alcohol; in such an event, the addition of a drop or two of alcohol generally suffices to clear the mixture.

This method enables one to use easily several stains in succession. Objects may also be colored, *in toto*, with the advantage that the process of staining can be followed and easily controlled.

Fixing and Preserving Histological Preparations.—Dr. N. Kultschitzky[3] discusses the merits and defects of the principal reagents employed in "fixing" and preserving histological preparations,

[1] Edited by C. O. Whitman, Director of the Lake Laboratory, Milwaukee.

[2] The carmine is boiled in the alcohol, and then the acid added. The solution is then filtered, hot, and enough ammonia added to neutralize. After filtering again the solution is mixed with turpentine and absolute alcohol.

[3] Zeitschr. f. wiss. Mikroskopie, iv., 3, p. 345, 1887.

points out the requirements to be fulfilled by such reagents, lays down the principles by which one should be guided in selecting them, and concludes by giving a method which has proved to be eminently satisfactory.

Rules.—(a) For fixing tissues it is important to use reagents that do not form tissue-like precipitates with protoplasm. This requirement is met by *chromic salts, sulphate of copper, sublimate* and some other salts. *Preparations in chromic salts, when transferred to alcohol, should be kept in absolute darkness* (H. Virchow), until the fixing reagent is removed so far as possible.

(b) All reagents which transform protoplasm into tissue-like forms, as, *e.g.*, chromic acid, should be avoided, or their application must be controlled.

(c) Fixing fluids should contain an organic acid, *e.g.*, acetic acid, which changes nuclein into an insoluble state. The acid must be used in a diluted form, as nuclein is dissolved in strong acids.

The time of action must be short, as the long-continued action of even a weak acid dissolves nuclein.

(d) It is desirable that the fixing fluid should contain alcohol in a small quantity.

Strong alcohol dehydrates and induces changes in the protoplasm.

Kultschitzky's Fluid.—Add, *ad libitum*, pulverized bichromate of potassium and sulphate of copper to alcohol (50 per cent.). Keep in absolute darkness twenty-four hours. A transparent greenish-yellow fluid is thus obtained, which is to be acidulated before use with acetic acid (5 to 6 drops to 100 cc.).

Method.—Place the object in the fixing fluid for from twelve to twenty-four hours, according to its size and hardness, and keep in the dark; then transfer to strong alcohol. After twelve to twenty-four hours the preparation is hard enough for cutting.

Conservation.—Kultschitzky thinks that for conservation only such fluids should be used as produce no further changes in protoplasm after it has once been fixed. As alcohol, Müller's Fluid and other fluids in common use do work changes in the tissues, Kultschitzky recommends keeping preparations in ether, xylol, or toluol.

Accessory Nuclei (Nebenkerne, Paranuclei).—Dr. Gustav Platner[1] has been for some years engaged with the problem of the origin and meaning of accessory nuclei in gland-cells. The results of his work have not yet been published, so far as I am aware; but some of his methods of study have been given in the *Zeitschrift für wissenschaftliche Mikroskopie*, Vol. IV., No. 3, p. 349. Flemming's *chrom-osmio-acetic acid* is the best hardening, or "fixing" medium. This mixture may sometimes be modified to advantage by diminishing the quantity of acetic acid and increasing that of osmic acid. When the accessory nucleus forms a compact mass, as in reptiles

and many anura, a mixture of picric acid and sublimate gives good preparations.

A New Staining Fluid.—Finding that hæmatoxylin varied considerably in its effects, according to the age of the solution, or the method of hardening employed, Dr. Platner looked for another staining substance that would better meet his needs. The search led to the introduction of a new stain, for which Platner suggests the name "*nucleus-black.*" This coloring substance is imported from Russia, and was obtained from the chemical laboratory of Dr. Grübler, Dufourstrasse, Leipzig.

A weak solution of nucleus-black stains only nuclei, nucleoli, and axis-cylinder, leaving the cytoplasm, connective tissue, and medullary sheath uncolored. Used at its full strength it stains other tissues, but with less intensity.

An over-stain is easily reduced by dilute ammonia (five or six drops to a watch-glass full of water), or, preferably, by *carbonate of lithium*, diluted *ad libitum*. A pure and intense nuclear stain may be thus obtained. Treated in this way, the accessory nuclei are stained in varying degrees of intensity, according to the stage of their development.[1]

It is a remarkable fact that these accessory nuclei, soon after their formation, become non-receptive to *safranin* or *Victoria blue 4 R*, while remaining stainable with *nucleus-black*. It would seem, as Platner remarks, that chromatin is composed of two substances, one of which is affected only by certain nuclear stains, while the other is receptive to a large number of stains, and especially so to nucleus-black and hæmatoxylin.

Sections from preparations in Flemming's fluid may be left twenty-four hours in a dilute solution of nucleus-black. The time of exposure to the decoloring fluid will vary according to the intensity of the stain received and the end to be reached. The stain is permanent and well adapted to photographing.

The Eggs of Ascaris megalocephala.—Platner recommends heating to 50°C., for twenty to forty seconds, then hardening in ascending grades of alcohol. This method has the great advantage of killing instantly without injurious effects, and leaving the nuclear figures in a better state of preservation than can be reached by any other method hitherto used. The egg-sacks are placed in a test-tube plunged in a dish of hot water. This method will undoubtedly be useful in other cases.

[1] Accessory nuclei arise from the chromatin of the nucleus, by a process of budding, and their development may be induced by starving the animal. On the sixth or seventh day, in the case of the salamander, the formation begins, and by the end of eight or nine days one or more accessory nuclei may be found in almost every gland-cell. As soon as the cells begin again to secrete, the accessory nuclei become pale and then disappear.

Bobretzky, Hertwig, Reichenbach, and others who have employed the method of heating, have subjected the eggs to a heat of 80°C., or more, and for a considerable length of time. Platner is unquestionably right in attributing previous failures in the use of this method to the unnecessarily high temperature employed. Max Schultze has shown that protoplasm is killed and stiffened at 50°C., and the use of a nearly boiling heat is therefore quite as unnecessary as it is harmful.

Paraffine prepared for Ribbon-cutting.—Dr. Spee[1] finds that paraffine prepared in the following manner is best adapted to ribbon-cutting:—

Take paraffine, which melts at about 50°C., and melt it over a spirit lamp. Keep hot for from one to six hours, until it assumes a brownish yellow color, like that of yellow wax or honey. When cold the mass is perfectly homogeneous, and without air-bubbles. Sections, if not over $\frac{1}{100}$ mm. thick, stick firmly together in the form of a ribbon.

[1] *G. F. Spee.* Leichtes Verfahren zur Erhaltung linear geordneter, lückenloser Schnittserien mit Hülfe von Schnittbändern. Zeitschr. f. wiss. Mikroskopie, ii., 1, p. 7, 1885.

SCIENTIFIC NEWS.

—The well-known traveler and Siberian explorer, Nikolai Michalowitsch Prjewalsky, died November 1st, in Karakul.

—Mr. T. H. Potts, an ornithologist, who has done much for the exploration of the New Zealand Fauna, has recently died.

—Professor Joseph F. James, M.S., formerly of Miami University, Oxford, Ohio, should be addressed after September 10, 1888, Agricultural College, Prince George's County, Maryland.

—The Lowell Institute free courses of lectures to the teachers of Boston begin January 5th, with a course by Prof. W. O. Crosby, of the Boston Society of Natural History, upon the geology of Boston and its vicinity. The course consists of (1) a general study of the physical features of the Boston Basin, and of the geological changes now in progress; (2) a systematic study of the various minerals and rocks found in the Boston Basin, together with the more characteristic kinds of structure which they exibit; (3) a

summary of the geological history of the district so far as that is plainly recorded in the rocks, tracing the gradual evolution of the present topographic and structural features from the widely different conditions which have prevailed in the past. The object of this course is to enable the teachers of the public schools of Boston an opportunity to become acquainted with the facilities that they have at hand for the illustration of many points in geology.

—THE THEORY OF THE ORIGIN OF SPECIES BY NATURAL SELECTION.—In the last number of *Science* (Nov. 16, 1888) Mr. H. S. Williams, of Cornell University, publishes a letter, in which he says that Robert Bakewell gave "a remarkably clear conception of the elements of the theory which Charles Darwin has made famous, almost thirty years prior to the appearance of 'The Origin of Species.'"

At first he gives some notes about artificial selection by R. Bakewell, which contain nothing new; artificial selection having been use from the oldest historical times.

Then Mr. Williams continues, stating that Mr. Bakewell applied this principle to explain the appearance of new forms of Mollusca.

But Mr. Bakewell's remarks have nothing to do with *natural selection* whatever. He simply says that forms are changed when brought into different conditions.

This is Transformism or Lamarckism, but not Darwinism!

Mr. Williams seems to ignore the fundamental difference between these two theories, in spite of the numerous recent able discussions on this subject.—*G. Baur, Yale University Museum, New Haven Connecticut.*

—The late Prof. Edward Tuckerman made a choice collection of books and papers relating to Lichens, some four hundred numbers in all, which has been presented by Mrs. Tuckerman, in accordance with his own wish, to Amherst College Library. It is proposed to keep the collection by itself under the name of the "Tuckerman Memorial Library," and to make it worthy of the name, by making it as complete as possible in its own department. Supposing that some persons interested in this specialty might like to assist in maintaining and completing the collection (with the understanding that it is always available to public use), I wish to give opportunity for any who care to do so to contribute, either in money or in material (especially rare monographs that may have escaped Prof. Tuckerman's notice), to this memorial to a model scholar and scientist. Whatever money may be contributed will be kept as a fund of which only the income will be employed in making additions to the collection, or in repairs and rebinding. The sum of $1000 would probably suffice as such a fund.

WM. I. FLETCHER,
Librarian of Amherst College.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

BOSTON SOCIETY OF NATURAL HISTORY.—November 7, 1888.—Prof. H. W. Conn, of Wesleyan University, read a paper on "Insect Larvæ and their relation to the adults"; and Mr. S. F. Denton exhibited models of animals prepared from a new material possessing many advantages.

BIOLOGICAL SOCIETY OF WASHINGTON.—The 131st regular meeting, December 1st, 1888.—The following papers were read: Dr. Th. Gill, "On the relations of the Psychrolutidæ"; Dr. C. Hart Merriam, "Description of a new Ground Squirrel from California"; Mr. F. W. True, "Remarks on the Deer of Central America," with exhibition of specimens; Prof. C. V. Riley, "Notes on the Economy of Thalessa and Tremex"; Prof. B. E. Fernow, "Causes of configuration of trees."

NATURAL SCIENCE ASSOCIATION OF STATEN ISLAND.—*February 11th, 1888.*—On motion of Mr. Hollick the following preamble and resolutions were adopted:—

Whereas, Our attention has been called to the title of a bill recently introduced in the Assembly, designed to allow the shooting of robins on Long and Staten Islands during the month of October, and,

Whereas, Such legislation would be a gross injustice to our Island, and would be a source of needless cruelty and destruction to our birds.

Resolved, That the Natural Science Association of Staten Island earnestly protests against the passage of this or any similar legislation, which tends to convert our Island into a legal shooting ground for the idle persons of New York and vicinity; and

Resolved, That copies of this preamble and resolutions be transmitted to the newspapers of the county and to our representatives in the Legislature, with the request that they use their best efforts to defeat the bill in question.

Mr. L. P. Gratacap made the following remarks upon the "boiling springs":—

During the very cold weather which visited us in January, culminating on January 27, and lowering the average night temperature to within a few degrees of zero, while the thermometer registered 12°–15° F. as its maximum in the day, the temperature of a group of springs on the hillside, south of Castleton avenue and near Bement, was taken. There were found to range from 44° to 53° F., the colder water being due to a less rapid flow and conse-

quently longer exposure at the springs' vent to the atmospheric influence. These springs, known as the "Boiling Springs," doubtless arise from below the impervious beds of clay, which may be seen outcropping along the sides of the gulches in the neighborhood washed out by freshets. While it seems unlikely that they issue from such a depth as sixty or eighty feet, which is assigned by Guyot as the limits of the zone of invariable temperature at our latitude, it is quite certain that points of origin are deep seated and almost, if not entirely, removed from superficial influence. The observation of Mr. W. T. Davis upon the Summer temperature of the Clove Valley springs corroborates this. He found that to be from 53° to 54°; almost identical with the Winter temperature of these springs at the coldest period of the season. The water flowing with this elevated temperature nourished an abundant growth of the common fresh water alga (*Conferva vulgaris* Rab.), which in turn supported in its thick and confused clusters numerous diatoms and infusoria. The green stems of a species of Veronica, too immature for determination, flourished abundantly in the tepid rivulet escaping from the tiny pools, while within a few feet last Summer's grasses were frozen in a crust of ice.

Mr. Wm. T. Davis read a portion of a letter from Mr. Aug. R. Grote. The extract is as follows: In 1856 I found *Clematis ochroleuca* growing on Kellett's Hill, near Egbertville, on the Southern slope near the top. My specimens went to the late Hon. Geo. W. Clinton, botanist, of Albany. I also collected a specimen of the fork-tailed flycatcher, *Milvulus tyrannus*, near our farm of Hill Park, towards the south-west side of the Island.

March 10th.—Mr. Arthur Hollick read the following notes, illustrated by drawings and dried specimens:—

During the Autumn of 1881 a species of sedge was found in company with *Callitriche verna* and *Dichelyma capillaceum* growing on the bottom of one of the springs near the present site of the S. I. Water Supply Co. It was proliferous, and showed no signs of either perfect flower or fruit, but as it was rather late in the season a more favorable time was awaited in which to collect and study it. The spring was deep, with walled sides and a clean sandy bottom and was never known to freeze, even in the severest winter. The plant was entirely aquatic—no part of it ever growing to the surface of the water. During the succeeding year it was visited from time to time in the hopes of obtaining either the flower or fruit, but without success. Specimens were however collected with aborted proliferous spikes, and it was finally admitted provisionally by Dr. Britton and myself into the Flora of Richmond county, in the appendix for 1883-84, under the name *Heleocharis prolifera* Torr (?). Since then it has been kept under constant scrutiny, but has never been found with flowers, and we were forced to conclude that it did

not produce any. It was naturally with some trepidation that it was determined to be this plant, as its habitat is given by Chapman, in his "Flora of the Southern States" to be from Florida to N. Carolina, and from there to Staten Island seemed a very extensive jump for the plant to take, without any intermediate locality from which it could have spread. Within the past six weeks, however, we have received specimens from the neighborhood of Trenton, N. J., which is a little more encouraging. It is well also to bear in mind that the place which this southern plant secured from its home so far north is just such a one as we would expect, namely, a perennial spring, which never freezes and in fact which maintains a constant temperature throughout the year of about 53°. So far as known, it failed to secure a foothold at any other locality on the Island, and the specimens which are now in our herbaria are probably the only ones which will ever be seen from here, as the spring has become silted up and all signs of life obliterated.

I was interested to find the following note in Dr. Torrey's monograph on the Cyperaceæ of N. America, p. 315-16: "Among my undetermined Cyperaceæ is a species of Eleocharis from the Southern States, which I have never been able to obtain with mature fruit. * * * * The spike is ovate and compressed, but instead of producing flowers it throws out a tuft of long filiform peduncles or rather culms, one from the axil of each scale, which strike root into the mud or float on the surface of the water and likewise bear proliferous spikes. * * * * I am inclined to consider this species as distinct from any other described in this monograph. It may be distinguished by the name of *E. prolifera*."

Again, in the Columbia College Herbarium, accompanying a specimen labeled *E. prolifera*, is a note by Dr. Torrey, which reads: "This may be a state of my *Chætocyperus baldwinnii* and the plant referred to in Baldwin's notes. * * * *"

Careful comparisons have been made between our specimens and those in the Columbia College Herbarium, under the names *Heleocharis baldwinii* Torr. and *H. prolifera* Torr., but our material is too imperfect to definitely determine just where it belongs. The specimens, while showing the general characteristics of the above-mentioned species differ in having a stiff jointed woody rachis, along which the spikes are arranged alternately, and at the summit of which they are closely appressed into a somewhat imbricated cluster. Several of the plants have also produced runners or stolons which bear the proliferous spikes at irregular intervals.

Mr. L. P. Gratacap presented a nest of the Baltimore Oriole, suspended from the branches of a cherry tree. One side of the nest had been supported by means of strands of worsted attached to a branch considerably above the main support, acting in the nature of a guy rope to steady the structure.

May 12th.—Mr. Wm. T. Davis read the following entomological notes of local interest. A very small straw-colored cricket was discovered last August on the borders of the salt meadow at Great Kill. It was chiefly observed on the stems and leaves of the "high tide bushes" (*Iva frutescens*), and was difficult to capture owing to its shyness. When stridulating the sound produced was quite metallic in tone and may be likened to that well-known silvery sound of oxygen escaping bubble by bubble in a water bottle. This insect has been identified as *Anaxipha exigua* Say., and seems to have never been reported before from north of Maryland.

The "earwig" (*Anisolabris maritima*), common several years ago on the shore of Camp Washington, before the advent of the railroad, as noted in the proceedings for January, 1887, was discovered the past Summer at the other end of the Island, on the shore at Tottenville. They live under stones and pieces of wood just at high water mark. On an open sandy spot near Tottenville a species of "tiger beetle" (*Cicindela modesta*), has been observed for the past several years, and last fall a few specimens were seen at Watchogue. These insects have been searched for at intervening points, where the same natural features are present, but have only been discovered at those mentioned.

A specimen of *Erebus odora*, the largest species of noctuid moth to be found on the Island, was presented to the Association. It was taken during last September while flying about a room, at New Dorp, by Miss M. Britton, and is in good condition. Two other specimens have been captured on the Island during the last few years in the month of July, one at "sugar" and the other in a barn. All of these moths are females, as indicated by the three frenula.

Mr. Samuel Henshaw reported the discovery of a wild rabbit's nest in a small pile of tobacco stems thrown out of a grape house. Its position was extremely exposed, the ground being perfectly bare of shrubbery, and workmen constantly employed near it during the day. The nest was small, about the size of an ordinary cocoanut and lined throughout with fur. It was visited by the mother at night only, who, when about to leave, concealed her four young by drawing the stems carefully over them. When the little rabbits were inspected at evening they uttered a faint cry, and if the hand was placed over them their heads bumped with much regularity against it, supposing no doubt that their mother had come to visit them. These inspections by curious visitors, and the danger from the family dog and cats that were constantly prowling about, caused the nest to be deserted and the young died when about two weeks old. The strong odor from the tobacco stems would greatly aid in protecting the nest from predatory prowlers, and it was suggested that the situation may have been chosen for this reason.

June 9th.—Mr. Samuel Henshaw submitted the following notes: The late spring of this year prevented the buds of the forest trees unfolding at their usual time, but when they did begin, their growth was astonishingly rapid. The horse chestnuts had finished their year's growth in nine days, the beech in about ten days, and other trees correspondingly rapid, as if nature was trying to make up for the delay. Indeed, I have noticed that no matter whether it is an early or late spring, by the first week in June all seasons are nearly alike.

The blizzard played queer freaks with the hardy trees; some Japanese maples, that have stood the last twelve years without any protection, have suffered—one is dead and the others have lost a few of their branches. Some of the hardy cypresses have lost all their leaves, and all the tall Lombardy poplars look in a very dilapidated condition, their long slender branches having been whipped by the strong winds, thereby rubbing off the latent buds. Some trees look as if the bark on the windward side had been polished, so great was the force of the beating with ice and snow.

Mr. Sanderson Smith gave an account of *Limax maxima,* which had accidently been omitted when preparing the recently published list of the Mollusca of the Island. The species is an introduced one, and was found some years ago by Mr. Powell at New Port. Mr. Prime and Mr. Smith had discovered it in a cellar in Fourteenth street, N. Y., and at York, Penn., it had been observed feeding on potatoes It has been found in numbers in cellars and cisterns on Staten Island.

Mr. Arthur Hollick gave a brief account of the plants which have been found growing independent of cultivation on Staten Island, of which the following is an abstract:—

Although the plants of the Island were catalogued in 1879, and four appendices subsequently issued, yet there are many facts to be gleaned from these lists which are not generally appreciated and are of considerable interest. Thus, there are 1,264 species and varieties enumerated, all of which are in our herbarium, with the exception of about 30, which have not yet been collected, although reported upon good authority. These species are distributed among 511 genera and 111 families. 1225 are Phanerogams or flowering plants and thirty-nine are the higher Cryptogams—ferns and their allies. The Angiosperms number 916, of which 377 are Polypetalous, 405 are Gamopetalous and 134 are Apetalous. The Gymnosperms number six. The Dicotyledones number 916 and the Monocotyledones 303.

If they are divided roughly into herbs, shrubs and trees, we have 1,094 herbs, eighty-eight shrubs and seventy-two trees. Considering them as native and introduced the numbers are about 1039 native and 225 introduced. The largest family is Compositæ, with its fifty-

one genera and 148 species. These latter include twenty-seven Asters and nineteen Golden-rods. Grasses—forty-three genera and 115 species, including nineteen Panicums. Cyperaceæ or sedges—ten genera and eighty-one species, including forty-three Carex. Leguminosæ—twenty-one genera and fifty-four species. Labiatæ—twenty-five genera and forty-eight species. Rosaceæ—thirteen genera and forty-seven species. Caryophylleæ—fifteen genera and thirty-eight species. Scrophularineæ—thirteen genera and thirty-two species. Ericaceæ—fifteen genera and thirty-one species, including eleven which are picked under the common name of "Huckleberry." Cruciferæ—fourteen genera and thirty-one species. Ranunculaceæ—thirteen genera and thirty-one species. Polygonaceæ—three genera and twenty-seven species, including nineteen Polygonums. Lilaceæ—sixteen genera and twenty.five species. Orchidaceæ—twelve genera and twenty-four species. Umbelliferæ—seventeen genera and twenty-two species. In the Ferns we have thirteen genera and twenty-eight species. There are twelve Violets, twelve Oaks, eleven Willows, five Hickories and four Pines. Amongst the large number of plants worthy of particular mention is the *Clematis ochroleuca* Ait., of which an account was given in the proceedings for June 11th, 1887. The "Crane-fly Orchis," (*Tipularia discolor* Nutt.), although accounted a very scarce plant, is abundant throughout nearly all our deep wet woods. Almost without exception all the most troublesome weeds have been introduced, such as the "Pig weeds," "Wormseeds," "Amaranths," "Crab grass," "Wild Carrot," "Ox eye Daisy," etc. Some of the worst weeds have spread so rapidly in recent years that although they are already pests yet no common name has been invented for them. For instance, I can well remember when the first few plants of *Galinsoga parviflora* Cav., made their appearance in this region. It is now to be found nearly everywhere at this end of the Island and is spreading with amazing rapidity. "Trailing arbutus" has almost become a thing of the past, although a few patches still exist, which have not yet been destroyed by "arbutus parties." General memoranda upon our flora will be found in the proceedings for June 13th, 1885, and an account of our forest growth and the few large trees yet remaining, in the proceedings for February 12th and March 12th, 1887. Memoranda have been accumulating since the fourth appendix to the flora was issued, which will probably necessitate a fifth appendix at the end of the present season, so that it will be seen that the work of the botanical collector on Staten Island is not by any means completed, especially when it is remembered that most of the lower orders of cryptogams have hardly been touched. The Diatoms are, however, being catalogued by Mr. E. A. Schultze, and a list of the sea weeds by Mr. Nicholas Pike, is ready for the printer, while a good preliminary list of the mosses

is in preparation; but the Liverworts, Lichens, Desmids, Fungi and Protophytes await the future botanist's attention.

October 13th.—Mr. Wm. T. Davis presented natural-sized drawings of leaf forms and fruit of the hybrid oaks found near Richmond Valley, with the following further remarks upon the same:—

Since the September proceedings were printed, the oaks near Richmond Valley have been visited several times by Mr. Hollick, Mr. Gratacap and myself, and they have proved of so much interest that a detailed description of at least some of the trees may be worthy of record.

Nineteen oaks have so far been discovered, each tree having a sort of individuality, and their consideration with a view to clearing up the mooted points is no easy matter, but one that will at least require an extended period of careful observation.

Some leaves represent what has been considered as *Quercus heterophylla*, and are from the tree which I first discovered while looking for willow oaks on the 15th of last July. It is two feet three inches in circumference and about forty feet high. The fruit was not plentiful this Fall. One leaf is the most common type, and there are some without any lateral bristles.

There are eight additional trees greatly alike, and each one, as has been remarked, shows individual character, but a general resemblance in branching, foliage and acorns runs through them all. The leaves are not glossy on the upper surface, but in a few of the trees are slightly downy on their under side, along the mid-rib. The character and position of these oaks would indicate that *Q. phellos* with *Q. palustris* are the parents and this latter tree abounds in the locality. The largest willow oak in the wood stands close to an equally big swamp oak and a typical *heterophylla* about six feet high is growing up within two or three yards of their trunks. This little tree is several hundred feet away from the others of its kind.

In *heterophylla* the average diameter of the empty cups is about three m. m. more than *palustris* and the heighth of the nut is also greater in comparison to its breadth. In *phellos* the acorns are still smaller than in *palustris*, but it is an interesting fact that the proportions come closer to those of *heterophylla*. In Chambers, Encyclopædia it is stated that in hybrids "valuable results are often obtained as to size and abundance of fruit."

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